A MANUAL

OF

LEGAL MEDICINE

FOR THE USE OF PRACTITIONERS AND STUDENTS OF MEDICINE AND LAW

BY

JUSTIN HEROLD, A.M., M.D.

FORMERLY CORONER'S PHYSICIAN OF NEW YORK CITY AND COUNTY; LATE HOUSE PHYSICIAN AND SURGEON OF ST. VINCENT'S HOSPITAL, NEW YORK CITY; MEMBER OF THE NEW YORK COUNTY MEDICAL ASSOCIATION, COUNTY MEDICAL SOCIETY, MEDICO-LEGAL SOCIETY, SOCIETY OF MEDICAL JURISPRUDENCE, NEW YORK ACADEMY OF MEDICINE, AND GERMAN MEDICAL SOCIETY OF THE CITY OF NEW YORK

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PREFACE

THE preparation of the following pages was undertaken at various times, during such brief intervals of leisure as the writer could spare from his professional duties. In offering the work to the legal and medical professions and to coroners, he fully realizes the fact that the field is already occupied by many excellent works on medical jurisprudence; but he long since became convinced, from his experience as a coroner's physician, of the need of a work of a somewhat different character, for the special use of those whose duties are such that they have neither the time nor the inclination to devote to the consultation of the more pretentious works now to be had.

The object of a great majority of medico-legal students, even of those who pursue a collegiate course, is not so much to familiarize themselves with minute details of facts or theoretical discussions as to understand the great principles of the science and the leading facts which serve for its foundation. To facilitate the accomplishment of this purpose is the object of the present work. In preparing it the writer makes no pretensions to originality, nor does he profess to be giving information that is in itself entirely new; but he does claim that he has prepared a book of medium size in which the attempt has been made not only to embrace the contents of the more elaborate and classic works, but to present them, together with original material hitherto unpublished, condensed into a comparatively small, but not too scant, space. As already intimated, the greater part of the matter has been drawn from the actual practice of the recognized medical jurists of the day, while a not inconsiderable portion of the book's contents reflects the actual practical experience of the writer himself. Recognizing that the work should be true to the science which it portrays, and present in exact proportion all its important features, yet at the same time be as practical as possible, the writer must acknowledge that the acme of this desideratum was reached only after considerable effort. So various and comprehensive are the subjects of legal medicine and toxicology at the present time, that the writer earnestly trusts that the magnitude of the work has in no manner interfered with that proper consideration of the different subjects which a work of this scope should exhibit, for he has endeavored to produce a volume which will fulfil all these requirements.

It is a curious fact that in no part of the civilized world is the subject of legal medicine more neglected as a scientific study than in this country; and

it may not be amiss to state right here that the present system of teaching this highly important branch of medicine in the medical colleges of the United States is highly defective; in reality, there are but a score (if that many) of institutions which treat of the subject at all, and even in these the study is by no means compulsory. Hence it is that the ignorance of medical witnesses as regards forensic questions is so wofully palpable. The well-educated physician, even though he be acquainted with all the other branches of medicine, is utterly incapable of solving important questions of medical jurisprudence. He is completely baffled when confronted by such intricate questions as those embracing infanticide, strangulation, suffocation, drowning, or others. And why is it that he displays such gross ignorance, notwithstanding the fact that he is well versed in all other branches of medical science? The plain reason is that none of the conditions of forensic importance are subject to solution by theoretical principles, but are comprehensible only when studied alone as facts. Young graduates in medicine are very often summoned hastily to cases which involve questions of medico-legal interest, when, to their utter dismay, they are confronted with the hopelessness of their position. What is such a person to do? To give an illustration: suppose a man has just been found dead from submersion in water, and the newly made doctor is called. His duty, as outlined for forensic purposes, will be to discern between death before immersion and death from submersion; whether any injury which may be detected was of *ante-* or *post-mortem* origin, etc. It is also his duty to ascertain whether the individual was strangled and then thrown into the water; whether he was drowned; whether *articulo mortis* was apparent when he fell into the water; or whether the person was in his usual good health at the time. There is no time for the hasty looking up of books, and, as foul play is suspected and a coroner's jury summoned to consider the results of the post-mortem examination, we can well imagine the awful responsibility which rests upon the physician; for it is possible that persons may be apprehended or subjected to trial for homicide on his testimony. Such an experience is liable to confront any physician, and may actually be presented within a very short space of time subsequent to his graduation. Hence the importance of improving and elevating the position of legal medicine in the medical institutions of this country. It is time that the attention of both the professions of medicine and law should be at least directed to this, the greatest deficiency in our medical education. Graduates of medicine should not be cast adrift by their *alma maters* without appreciating their responsibility to the State, and it becomes the bounden duty of every institution of medical learning to at least equip their students with a knowledge of the more important of forensic questions.

In the present volume everything that is practical and useful has been inserted, and all idle and superfluous questions which are still *sub judice* are dispensed with. Simplification has been the motto of the writer, so that any person possessing ordinary intelligence may benefit thereby.

This book is divided into two parts. The first relates to Toxicology. The body of the work commences with a short dissertation treating of principles, or, in other words, furnishing the reader with the medical and legal definitions of a poison, together with the administration, effects, absorption, elimination, and antagonism of these deleterious substances. The second chapter of the first part, entitled Evidences of Poisoning, includes remarks relative to poisoning in the living, evidences from the symptoms, diseases simulating poisoning, and the general treatment of these cases. The Evidences in the Dead Subject are then discussed, together with questions of forensic importance relative thereto. Chapters III. and IV. embrace the rules and duties to be observed in poison cases, and the classification of these substances. The remaining chapters of Part I. are devoted to a discussion of the various drugs, with the exception of Chapter XVI., which comprises those poisons formed during the process of decomposition,—ptomaïnes and other putrefactive products. Embalming in its medico-legal aspect is also included here. The more important poisons (morphine and opium, nux vomica and strychnine, belladonna and atropine, arsenic, hydrocyanic acid, phosphorus, etc.) have received special attention.

The science of toxicology is rapidly progressive, and, in order to keep fully up with its advancement, new matter has been introduced, and such changes and modifications made as the progress of the science seemed to require. New cases have also been added (*vide* Appendix), notably those of Carlyle W. Harris, Dr. Meyer, Holmes, and Dr. Robert W. Buchanan. These add to our knowledge the various phases of the respective poisons with which the cases are associated.

The second part of this work relates to Forensic Medicine proper. Within its limits will be found every subject of importance relative to this branch of medicine, with the exception of insanity and its allied branches.

Under Chapter XVII. the Powers and Duties of Coroners are defined. This part also includes The Criminal Court, Evidence, Ordinary and Expert Witnesses, and Dying Declarations. Other chapters include the Phenomena and Signs of Death ; Presumption of Death and of Survivorship ; Hairs and Fibres ; Burns and Scalds ; Death by Heat and Cold ; Death by Starvation ; Railway Injuries ; Feigned Diseases, etc. ; Pregnancy ; Criminal Abortion and Infanticide ; Legitimacy, Inheritance ; Impotence, Sterility ; Rape ; Life Insurance ; Medical Malpractice ; and the Medical Examination of the Living.

Under Medico-Legal Autopsies (Chapter XX.), special reference has been made to the technique of post-mortem examination. Since the medical examiner should work unencumbered by the minute consideration of the various appearances of pathological changes, which but decrease the value of the various practical details, only general and comprehensive statements have been made. In Chapter XXII. (Personal Identity) will be found a synopsis of the Bertillon System of Identifying Criminals. This system of identification, which is in use in various parts of Europe and this country, was adopted by the Police Department of New York City, March 6, 1896,

to replace the former antiquated methods. This system of measurements and descriptions, together with the photographs of criminals, may be said to furnish an almost perfect test of identification. Commissioner Andrews, in his report to the Board of Police Commissioners of New York City, says that "the system is not a means of detecting crime and criminals in the first instance, but a means of identification, and a complete, accurate, and indisputable record of the criminal classes. There are now in the department three thousand photographs of criminals. While of service, these are manifestly inadequate and primitive. In the central office of the prefecture of police in Paris there is now the fullest and most detailed record by the Bertillon system of more than one hundred and fifty thousand of the chief criminals of Europe. The things which commend the system most are the reliability of the standard of measurements and the ease of index. The Chinese use the imprint of the thumb, which, while interesting and reliable, is impossible of index. The success of the system depends upon three facts, which Bertillon considered of great importance, and which many years of experience have rendered indisputable:

"*First.* The almost absolute fixity of the human skeleton, beginning at and after the twentieth year of age.

"*Second.* The extreme diversity of dimensions which the human skeleton presents when one subject is compared with another.

"*Third.* The facility and relative precision with which certain dimensions of the skeleton are capable of being measured."

The measurements adopted were as follows:

"*First.* Three body measurements, consisting of height standing, stretched-out arms, and height sitting.

"*Second.* Four head measurements, consisting of length of head, width of head, length of right ear, and width of the same organ.

"*Third.* Four limb measurements, consisting of length of foot, length of left middle finger, length of left little finger, and length of left cubit."

"All these measurements can be taken in a few minutes by an ordinary operator." (The reader is referred to page 199 for a more detailed description of this system.)

Under Chapter XXIV. the consideration of Blood-Stains is taken up. In this connection might be mentioned the incorporation of the opinions of the latest authorities regarding the medico-legal importance of the red blood-globules in homicide cases. This is one of the largest chapters in the book, and embraces such important subjects as the Form and Direction of Blood-Spatters, the Effects of Reagents, the Preliminary Examination of Suspected Stains, etc.

The largest portion of the work is devoted to the medico-legal consideration of Wounds. This subject is treated of as Wounds in General, Wounds Regionally Considered, and Gunshot Wounds, the whole being

dilated upon in three chapters,—*i.e.*, Chapters XXV., XXVI., and XXVII. respectively. Violent Death from Different Forms of Apnœa is discussed in Chapters XXIX., XXX., and XXXI., the subjects, treated in the same order, being Suffocation, Strangulation and Hanging, Drowning, together with the Medico-Legal Aspects of Electricity, including the mode of judicial execution in New York State (Electrocution) and the Effects of Lightning.

At the end of the book will be found an Appendix, which gives various important cases, etc.

The writer has now to return his most grateful thanks to Civil Justice George F. Roesch, of the Fourth District Court of this city, for his exceedingly interesting chapter on Pharmaceutical Jurisprudence. He also has endeavored, to the best of his ability and recollection, to acknowledge, in the course of the work, the sources from which he has culled information. The extracts from other writers have been introduced in their original language, except in those instances where it was deemed necessary to make some slight changes to incorporate the quotation the better with the passage with which it comes in connection. Among the works from which the writer has extracted freely, and to which acknowledgments are due, are the elaborate and standard ones of Witthaus, Hamilton, Tidy, Reese, Taylor, Wharton and Stillé, and others (*vide* Bibliography of Authorities, Appendix).

The writer has endeavored to adhere to a systematic arrangement throughout the work. This has been done as far as was practicable, but in certain instances it has been departed from; especially was this the case where it became obligatory on his part to introduce new facts that had arisen after the parts of the book to which they belonged had been finished. The table of contents and the index have been prepared with extreme care, so that the detached pieces of information referred to above will be readily found when looked up.

Should any errors of commission or omission be discovered by readers, the writer asks their indulgence, as the work has been prepared in the midst of a busy professional career.

JUSTIN HEROLD.

NEW YORK CITY, September, 1897.

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PART I

TOXICOLOGY

A MANUAL OF LEGAL MEDICINE

CHAPTER I.

INTRODUCTION.

Definitions of a Poison—Administration of Poison—Effects of Poisons—Absorption —Elimination—Modification of the Action of Poisons—Antagonism of Poisons.

Toxicology is that branch of the science of medicine which treats of the nature, properties, and effects of poisons. Its object is the prevention or cure of all forms of poisoning. *Forensic toxicology* refers to the detection of criminal poisoning.

A poison is a substance which, when applied to the body externally, or introduced into the system either by the mouth, rectum, vagina, skin, lungs, etc., without acting mechanically, but by its own inherent qualities, is capable of altering or destroying some or all of the functions necessary to life.

The intent with which such a substance is given enters into the legal conception of a poison. The law never regards the manner in which a substance acts, and it is of little consequence, so far as the responsibility of the accused person is concerned, whether its action on the body be of a mechanical or of a chemical nature, so long as the substance administered is capable of causing disease or death. Broken or crushed glass, needles, pins, and like bodies are not poisons in the medical signification of the term, yet, when taken inwardly, may be destructive to life. Any substance which causes disease or death, given with homicidal intent, may be regarded as a legal definition of a poison.

Administration of Poison.—Poisons may be introduced into the body in various ways and in various forms. They may be given by the mouth or by the rectum, by the vagina or by the respiratory organs, or subcutaneously, etc. The gastro-intestinal tract is the most usual avenue of access into the body; but the rectum, vagina, skin, lungs, etc., are also readily accessible as channels of entrance; and even the ears and nose have been

utilized for the criminal administration of poison. It is usual for poisons to act more rapidly when given by the mouth than by the rectum or vagina; still more so when introduced into the system by hypodermatic injection; and most powerfully when thrown directly into the blood. The inhalation of poisonous vapors or gases through the respiratory tract affects the system with remarkable rapidity, because of the activity of absorption being superior to that of most other mucous membranes.

Poisons may be administered in the form of solids, solutions, or gases and vapors, alone or in combination with various matters.

The legal significance of a poisonous or non-poisonous material is not affected by the mere *size* of the dose of a poison, and no distinction exists between the two; thus, half an ounce of oxalic acid may prove as fatal as half a grain of strychnine.

Effects of Poisons.—The effects of poisons are usually considered as local and remote. The *local* effects are the direct impressions produced on the tissues of the body with which the deleterious material comes in contact. These effects are mainly of three kinds,—viz., (1) *Corrosion*, or *chemical decomposition*, as is observed in the effects of the strong alkalies and mineral acids on the mucous coats of the stomach and intestines; (2) *Irritation*, the extremes of which are simple inflammation or redness and ulceration or gangrene. Irritation or inflammation frequently follows the use of corrosive sublimate; (3) *A local specific effect*, which is manifested by certain poisonous substances, on the sentient terminals of various nerves, as is experienced on the local application of aconite, prussic acid, etc.

The *remote* effects of a poison are those results which are produced on organs situated at some distance from the part to which the substance has been applied; for example, opium, after having been taken into the stomach, exerts its peculiar narcotic effects on the brain.

Frequently a poison may act both locally and remotely, as cantharides, for instance, which affect the part to which they are applied, in producing blisters; their remote effects influencing the kidneys and bladder, causing strangury and occasionally bloody urine. Most poisons, however, no matter in what way they are introduced into the body, are rapidly absorbed and disseminated through the blood, exerting their influence on those organs which are peculiarly sensitive to their action. In this manner the poison soon reaches some one of the great centres of life,—the brain and spinal cord, the heart, and the lungs,—and there spends its effects. Thus, opium exerts its narcotic effect on the brain; digitalin or prussic acid acts on the heart, causing asthenia; strychnine produces tetanic convulsions by attacking the spinal cord; and so on with other poisons which have an elective affinity for various organs.

Absorption of Poisons.—A poison to produce its peculiar effects on the system must pass into the blood,—that is, it must be absorbed into the general circulation. The degree of absorption depends, to a certain extent, upon the diffusible nature of the poison itself, for it is a well-known fact

that some agents are more readily taken up by the system than others. Another point of interest is that some textures possess the power of absorption through them more than others; serous membranes, for example, permit of absorption more quickly than mucous membranes. On account of the impermeable nature of the skin, absorption is sluggish through the unbroken cuticle. Poisons taken into the empty stomach manifest themselves by their specific effects in a short space of time, and act much more rapidly than when that viscus is loaded with food. Some poisons are rapidly taken into the general circulation, while others are slow in showing their effects.

The proofs of absorption are shown by the detection of the substance in the blood, secretions, or various viscera of the body. The discovery of a poison in the stomach by the toxicologist would not be absolute proof as to the cause of death in an individual supposed to have been poisoned, because cases are recorded where the deleterious agent has been introduced after life has departed. Hence, the duty of the examiner is to ascertain the existence of the poison, in the ***absorbed*** state, in various other viscera.

The rapidity with which absorption takes place will depend on the solubility of the substance employed, the relative fulness of the blood-vessels, and the nature of the surface to which the poison is applied. Bleeding or purging through depletion of the vascular system will favor absorption.

Elimination of Poisons.—The elimination of a poison takes place through the agency of the various excretions, such as the bile, urine, saliva, pancreatic fluid, and perspiration. Elimination is not an immediate result of the passage of a poison through the different organs, for a portion of the substance is deposited for a variable period of time in the organs and tissues. This deposition usually occurs in the following order as to quantity: the liver, spleen, kidneys, heart, lungs, brain, pancreas, muscles, and bones. Gaseous poisons are eliminated at once by the lungs without deposition.

Some poisons are eliminated or deposited more rapidly than others, which goes to show that the time required for either of these processes will depend entirely upon the poison itself and the state of the patient's system at the moment of its ingestion. For example, some poisons make their appearance in the urine within a few minutes after being taken into the body. Arsenic may be found in the liver a few hours after its administration. The salts of lithium pass through the entire circulatory system after the lapse of some minutes, and may be found in the perspiration. With various other poisons a greater length of time is required for their elimination; antimony, for instance, being found four months after its ingestion.

The proportion of poison circulating in the capillaries at any one time to that found in the stomach is exceedingly small, but it is sufficiently large to create the impression that its influence is of a noxious nature. It is, in fact, due to this small portion of poison that the deleterious effects continue so long as the circulation of the blood goes on in the capillary vessels. The poison which becomes stored in the stomach or in other organs, for the time being, is really innocuous, and remains so until again taken into the circulation.

Modification of the Action of Poisons.—The most important of the modifying agencies connected with the poison itself is the *quantity* or *dose.* As a general rule, the larger the quantity the quicker the effect. For example, there are many drugs which are exceedingly poisonous in large doses, while in small amounts they prove useful as valuable remedies; such substances are arsenic, opium, digitalis, prussic acid, etc.

Then, again, the mode of administration is of consequence. Dilute diuretics, for instance, act more powerfully than when concentrated, while saline purgatives have better effect when given in the latter condition. The chemical constitution of a poisonous substance is an important modifying agent.

The more soluble a compound is, the more speedily are its effects produced. Inert substances are those which are insoluble in water, yet certain conditions of the digestive organs must be considered when discussing them. Thus, orpiment is insoluble in water, but when administered internally may show signs of poisoning. The poisonous material, to be absolutely inert, must be insoluble not only in the suspending fluid, but also in the digestive fluids, else it might find its way into the system, thereby causing fatal results.

Some persons are more susceptible to the influence of poisonous substances than others. A tolerance to certain poisons is a bodily condition influenced, to a certain extent, by habit. When a substance is habitually taken into the system, the latter becomes accustomed to its effects, and larger quantities are necessary to reproduce them. This is well seen in the arsenic-eaters of Styria and other mountainous countries, where enormous quantities of arsenic are annually consumed, and in a less degree in the practice of opium-eating and smoking as observed throughout the civilized world.

Men generally bear larger doses of poison than women; and, as a rule, the larger and more robust the individual, the less easily is the influence of the drug shown. Some persons are very susceptible to the effects of certain plants, while others may even handle them with perfect impunity. Some are easily influenced by minute doses of arsenic; others cannot take quinine, opium, belladonna, etc.; and in others very dilute solutions of otherwise harmless preparations may cause the most alarming symptoms. (*Vide* p. 55, foot-note.)

Mental and bodily conditions play an important part in the modification of the action of poisons. Sedatives produce no effect in certain convulsive disorders, though they may produce serious results when administered to otherwise healthy individuals. Again, there are certain animal and vegetable substances, such as the venom of reptiles, and curari, most virulent when introduced into the blood, which may be swallowed with perfect impunity. The active ingredients of various articles of food are sometimes virulent poisons.

During the process of digestion larger amounts of poisons are borne than can be taken when abstaining from food.

Disease modifies the action of poisons. Enormous doses of opium can be taken in certain affections like cerebro-spinal fever and peritonitis. The tolerance of alcohol is manifest in typhoid fever, etc. Persons suffering from such diseases as inflammation of the brain and apoplexy are very susceptible to opium, as also are nephritics. It is important to remember that absorption is slow in certain conditions of the alimentary canal, as in some of the stages of cholera and yellow fever, during a congestive chill of the gastro-enteric variety, etc. Absorption may not take place at all during profound narcosis.

A state of the system particularly proof against the effects of powerful poisons is not easily found. Cases of acquired idiosyncrasy are very rare, for the peculiarity appears to be a congenital condition.

Antagonism of Poisons.—The researches of Ringer, Frazer, and others have demonstrated the fact that there exists an antagonism between certain poisons.

The experiments of these observers prove a physiological and a toxic antagonism. Ringer observes that toxic doses of the calcium salts produce complete ventricular contraction in the frog's heart, the animal succumbing to the influence of the drug, with the heart in systole. On the other hand, relaxation of the ventricle and death in systole follow poisonous doses of the potassium salts. The physiological effects of these salts can be neutralized, however, by a careful regulation of the dose, whereby the healthy action of the heart is restored.

Certain other poisons, such as veratrine, morphine, aconite, and conium, are more or less neutralized by the following antagonists, respectively: potash salts, atropia, digitalis, strychnine, etc. On the same principle many other poisons are found to possess a similar antagonism.

CHAPTER II.

EVIDENCES OF POISONING.

Remarks relative to Poisoning in the Living Subject—Evidences from the Symptoms—Diseases simulating Poisoning—General Treatment of Poisoning—Evidences of Poisoning in the Dead Subject—Remarks—Evidences from Post-Mortem Appearances—Chemical Analysis—Experiments on Living Animals—Post-Mortem Imbibition—Circumstantial Evidence—Medico-Legal Queries.

THE chief characteristics of poisoning are afforded by the symptoms, which usually make their appearance shortly after the ingestion of food, drink, or medicine. Sudden illness occurring in a healthy individual after swallowing any substance strongly suggests a suspicion of poisoning, which is much strengthened if several persons are affected in the same way, after

having partaken of the same food or drink. It is extremely difficult to determine, from the symptoms alone, whether a person is suffering from poisoning or not, for there are various other circumstances which must be taken into consideration before arriving at any positive diagnosis.

A correct knowledge of the symptoms, however, furnishes the chief evidence of poisoning in the living, and it becomes of paramount importance for the physician to be familiar with them as they arise, and be able to differentiate between the signs of poisoning and those following the course of natural diseases.

There are many affections the symptoms of which bear close resemblance to those caused by the ingestion of poisons. Thus, cholera, cholera morbus, ulcer of the stomach, peritonitis, etc., present similar signs to various forms of poisoning. The symptoms of apoplexy, epilepsy, tetanus, convulsions, etc., are very much like those occasioned by the narcotic and neurotic poisons. Rupture of the intestines, of the biliary ducts, uterus, or Fallopian tubes, aneurism, etc., have been confounded with cases of poisoning.

If each poison presented its own characteristic symptoms, there would be no better evidence of the existence of poisoning; but, as such is not the case, it becomes obligatory on the part of the toxicologist to use other methods, such as making a chemical analysis, etc., of the various parts of the body, ere arriving at any definite results.

Evidences from the Symptoms.—The effects of most poisons are very rapidly produced, and, as mentioned above, their chief characteristic is their sudden appearance in a perfectly healthy person, soon after taking food, medicine, or drink. On the other hand, it is well to remember that there are many exceptions to these rules. Thus, very small quantities, given at intervals, may delay the appearance of the symptoms, which usually come on gradually, as in cases of slow poisoning. These may be easily mistaken for those arising from disease. Again, the individual poisoned may have an overloaded stomach, or be suffering from disease for which medicine may have been administered, thus aggravating or delaying existing symptoms. The fact must not be overlooked that the symptoms of poisoning may remit for a time. And, lastly, the symptoms are, as a usual thing, uniform in their nature throughout their course, and more or less rapid toward a fatal termination.

The symptoms of poisoning are usually ushered in with violent pain, vomiting, purging, and convulsions; or there may be delirium, or great drowsiness, as is observed in opium narcosis.

The chief characteristic of the *corrosives* is their destructive action on the tissues with which they come in contact. There is always intense thirst, with a burning pain in the throat and stomach, nausea, and vomiting of matters which contain shreds of mucus, darkened blood, and portions of mucous membrane. Dysphagia and dyspnœa are also prominent. After considerable suffering the patient becomes exhausted, the face anxious and imploring, the pulse being small and frequent and the skin cold and clammy. The symptoms indicate the corrosive action of the poison.

(Among the different classes of corrosives are the mineral acids, the caustic alkalies, their carbonates, and corrosive sublimate. Carbolic acid, strong solutions of oxalic acid, etc., belong to the organic class of corrosives.)

The *irritant* poisons cause burning and constriction in the œsophagus and throat, pain in the stomach and intestines, nausea, vomiting, thirst, purging, bloody stools, dysuria, and an irregular and feeble pulse.

(Irritants may be of two kinds,—viz., local irritation, such as is produced by the principal vegetable irritants, the less active metallic poisons, and irritant gases, and specific remote effects, such as are the result of poisoning by arsenic, antimony, lead, copper, cantharides, etc.)

Poisons which act on the brain are divided into three classes,—viz., the *opium group*, producing sleep; the *belladonna group*, producing illusions and delirium; and the *alcohol group*, producing exhilaration, followed by sleep or delirium.

The symptoms arising from the *first*, or *opium group*, are giddiness, headache, tinnitus aurium, dimness of vision, contraction of the pupils, confusion of the intellect, and drowsiness, merging into insensibility. Breathing is stertorous, and the skin is cold and clammy.

The *second*, or *belladonna group*, causes dilatation of the pupil, spectral illusions, thirst, dryness of the throat and mouth, and delirium. There may be paralysis and tetanoid convulsions.

The *third*, or *alcohol group*, exhibits the loss of power of co-ordination and of muscular movement, excitement of the cerebral functions and of the circulatory apparatus, diplopia, profound sleep, and deep coma. Delirium tremens is characteristic of the chronic form of alcoholism.

Of the poisons acting on the spinal cord (strychnine, brucine, etc.), the leading symptom is the tetanic spasm, which lasts from one to five minutes, with intervals of perfect relaxation. Other poisons than strychnine, etc., may produce tetanic convulsions, and it is well to recollect this, although the diagnosis is usually not very obscure nor difficult, as the tetanus in this instance will be generally complicated with other symptoms, whereas in strychnine-poisoning the one great and prominent sign is the tetanic spasm.

Poisons affecting the heart, among which are oxalic acid and the oxalates, digitalis, aconite, prussic acid, and tobacco, cause death by sudden shock, syncope, or collapse. Those acting on the lungs, such as carbonic acid gas, etc., produce asphyxiation.

Poisoning is frequently feigned, and at other times imputed. A poisonous draught is sometimes substituted for a harmless medicine.

Diseases simulating Poisoning.—The differential diagnosis between strychnine-poisoning tetanus and that arising idiopathically is as follows: In the tetanus of the former the development of the symptoms is accomplished in a few minutes; the trismus may be absent, or it is imperfect. The opisthotonos is very violent, and appears early in the convulsion. The spasms are *clonic* and intermittent, and deglutition is peculiar, but perfect. In the

tetanus of *idiopathic* origin the supervention of the symptoms is gradual, though being at first rather obscure. The earliest and most prominent symptom is the condition known as lockjaw (trismus), which is almost perfect in its form. The trismus is followed by stiffness of the trunk and extremities; the *facies tetanica* is much more marked than in strychnine-poisoning. The spasms are *tonic* and very persistent. Intermissions rarely occur. Deglutition is very difficult and tedious, on account of the locked condition of the jaws, and, when the mouth is spasmodically closed, impossible.

Epilepsy and hysteria likewise produce convulsions similar to those just mentioned; but the general history of the case, together with the nature of the spasms, with the rapid alternations of relaxation and contraction, and the rarity of fatality, will assist materially in reaching a correct diagnosis.

Coma and insensibility are prominent symptoms of many of the diseases of the nervous centres which greatly simulate those occasioned by narcotic poisoning.

The greatest difficulty which confronts the toxicologist consists in differentiating between the symptoms of poisoning and those of disease. The diseases which closely simulate poisoning by the *corrosives and irritants* are acute gastritis (rarely occurs idiopathically), Asiatic cholera, cholera morbus, gastro-enteritis and all acute inflammations of the alimentary canal, peritonitis, ulceration of the stomach, ileus, and hernia. The diseases which resemble *neurotic* poisoning are epilepsy, apoplexy, inflammation of the brain, and various affections of the heart.

Asiatic cholera produces symptoms which resemble the action of tartar emetic, such as the cramps, nausea and vomiting, rice-water evacuations, extreme weakness, etc. Blood is seldom found in the vomit of cholera, while it is of common occurrence in irritant poisoning. Purging is an early symptom in this disease, being somewhat slow in making its appearance in poisoning. Pain and constriction are rare.

Cholera morbus bears a close relation to arsenical poisoning and other irritants. Reese[1] mentions two cases, which came under his notice, where arsenical poisoning was mistaken for cholera morbus by the physician in attendance. Gastro-enteritis, peritonitis, ulceration of the stomach, ileus, and hernia strongly resemble, in their symptoms, those of the irritant poisons.

In *apoplexy*, symptoms are presented which bear close resemblance to those of opium-poisoning. It is necessary for the observer to note the general premonitory symptoms, and also to recollect that apoplexy usually attacks the aged. The apoplectic sleep is frequently most profound, and it is often impossible to arouse the patient.

Epilepsy may be confounded with the symptoms of prussic acid. The arrival at a correct diagnosis will be guided by considering carefully the history, the chronic nature, and the peculiarity of the epileptic paroxysms.

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[1] Medical Jurisprudence and Toxicology. Third edition, Philadelphia.

Similar symptoms to those caused by narcotic, etc., poisoning take place in hydrocephalus, fever, uræmic poisoning, and injuries or blows on the head.

General Treatment of Poisoning.—The first indication is to eliminate the deleterious substance from the system, and meanwhile, if possible, prevent its absorption.

Some poisons act as their own antidotes by producing an emetic effect,—that is, they evacuate the contents of the stomach. When such is the case, the use of warm water will materially aid in removing any small particles, tenacious mucus, etc., which might adhere to the walls of that organ.

If free vomiting does not occur, then recourse must be had to the stomach-pump or tube, because the use of this instrument is not attended with the exhaustion that is liable to succeed repeated vomiting produced by the free administration of emetics. This method, however, is not always admissible or convenient, and the use of emetics is necessary. A good rule to follow is to never wait for a remedy, if an imperfect one is at hand, for that is *best* which is readiest.

Of the many emetics, the sulphate of zinc, in twenty-grain doses, is the best. Sulphate of copper, in six- or eight-grain doses, has been effectual in certain instances where other emetics have failed, as in the poisoning of narcotics; its action, however, is of an irritant nature, and may increase instead of diminish the poisonous effect.

Other methods of producing an evacuation of the stomach contents are by giving copious draughts of lukewarm water, tickling the fauces with a feather, or allowing the patient to drink warm water impregnated by one or two teaspoonfuls of ground mustard. A handful of common salt in a pint of lukewarm water is also efficacious. The hypodermatic injection of one-tenth of a grain of hydrochlorate of apomorphine may be administered when the sufferer is unable to swallow; its use, however, is rather depressing.

When discussing the antagonism of poisons, reference was made to the character of the antagonism existing between certain poisons. This was found to be twofold,—viz., physiological and toxic. Therefore, when considering the treatment, the action of the *antidote* may be regarded as physiological and chemical. Our object must be to neutralize the effects of poisons on the general system by administering remedies of an opposite character. Thus, for example, morphine antagonizes atropia, and atropia neutralizes strychnine; or, digitalis counteracts the poisonous effects of aconite, and so on.

If all these fail, the next process is to stop the action of the poison. This is accomplished by giving some antidote which will combine with the poison in the stomach, forming a substance which is insoluble or inert. Ferri oxidum hydratum cum magnesia, for instance, is the reputed antidote for the arsenical preparations.

In treating poisoning by the vegetable compounds it is well to make the patient drink a pint of water containing ten to twenty grains of tannin, or an infusion of green tea; for the tannic acid unites with the poisonous alka-

loids, and also with tartar emetic, forming compounds which are insoluble in water.

For corrosive sublimate and other mercurial salts and the salts of copper, albumen is the remedy. For the nitrate of silver, common salt in solution is appropriately given. For the mineral acids, the administration of chalk or magnesia, soap, and the alkaline carbonates is advised, or whiting from the wall, etc., when other remedies are not available. Alkalies must be avoided in oxalic-acid-poisoning, since they form poisonous compounds, and the antidote to be given is magnesia and chalk.

Ammonia, potash, and soda are treated with vinegar or the diluted vegetable acids.

When the poison taken is known, the chemical antidote is frequently indicated with precision. For example, when carbolic acid and sugar of lead are the poisons, they are rendered inert by administering a soluble sulphate, as Epsom or Glauber's salt, the carbolic acid being transformed into a harmless sulpho-carbolate, and the sugar of lead into an insoluble powder.

Animal charcoal has been advocated as an antidote to poisons, although its action is somewhat mechanical ; it has the power of absorbing alkaloids, which may render it useful.

The third indication should be devoted to the relief of the suffering experienced by the patient and obviating the tendency to death. If absorption of the poison has taken place, direct antidotes will be of little avail. The relief of suffering is called for principally by poisons of a purely irritant class. Cool, bland, and protective liquids relieve the burning pain experienced in the stomach and intestines or the eroded condition of the mucous membrane. Relief is hastened by the application of mustard to the pit of the stomach ; but opium is our chief anodyne, particularly applicable in aggravated cases. Attend to the shock, etc.

Our object must be to alleviate the symptoms as they present themselves.

Evidences of Poisoning in the Dead Subject.—In seeking for evidences of poison in the dead body the legal physician must endeavor to ascertain all the particulars which have already been incidentally touched upon,—viz., the symptoms, etc., as indicative of poisoning in the living subject. Besides, the circumstances of the attack must be considered.

The evidence furnished by the *time* at which death takes place after the first occurrence of symptoms, like that derived from the symptoms, can never be absolutely conclusive, although the more common poisons produce their fatal effects within certain periods of time. Attention to this point may be the means of *denying* a charge of poisoning, or, in other instances, enable the observer to form an opinion as to the *kind* of poison administered.

The legal physician may be called upon in court to specify the usual time within which poisons prove fatal. Poisons differ from each other in this respect, and the same substance will differ in its action when the form or quantity is subjected to a change. Prussic acid, when given in large doses,

may cause death in less than two minutes, but in ordinary cases of poisoning by this substance life may be destroyed in from ten to twenty minutes. Should a patient survive half an hour, the chances of recovery would be favorable. Oxalic acid may prove fatal, when taken in doses ranging from half an ounce to an ounce, within an hour, although cases are on record where death resulted within ten minutes. The rapidity with which fatality occurs will depend, to a certain extent, on whether the poison was perfectly dissolved or not. Death has been prolonged to the fifth day in such poison cases. The smallest amount of oxalic acid necessary to kill is one drachm.

Poisonous doses of the strong mineral acids mark their fatality in from nineteen to twenty-four hours. The shortest period of time at which death takes place in nitric-acid-poisoning is one hour and three-quarters. Fatal results have followed half an ounce of hydrochloric acid in two hours. Phosphorus causes death usually from the third to the seventh day. Arsenic operates fatally in from eighteen hours to three or four days. In some instances, however, it has caused death within twenty minutes.

Opium sometimes proves disastrous in three-quarters of an hour. The average time may be stated at seven to twelve hours, and if the patient survive the latter time, the chances of recovery are good.

These statements are merely average results, and it is of importance to recollect that the fatal period may be lengthened or shortened, according to all those circumstances which have been alluded to when discussing the actions of poisons.

Attempts have been made to negative a charge of poisoning on the ground that death may have been too rapid or too slow to justify the suspicion. Careful observation of numerous cases proves that fatal results may rapidly follow the action of various poisons.

Unfounded suspicion of poisoning frequently arises where the death of a person has been sudden. Unjust imputations are thereby often cast upon innocent people. The fact must not be forgotten that there are many diseases which commence suddenly and rapidly progress toward a fatal termination. For example, apoplexy or diseases of the heart frequently end fatally instantly, or within an hour or so.

Of the poisons, prussic acid, for instance, acts fatally with remarkable rapidity, while poisoning by opium is commonly protracted for several hours before death takes place.

The additional evidences to be derived from the death of an individual may be considered as follows :

Evidences from Post-Mortem Appearances.[1]—Although one of the chief methods of determining whether a person has died from the effects of poison, the evidences furnished by the post-mortem examination, like those derived from the symptoms, can never be but strongly suggestive, because numerous diseases present very similar pathologic conditions.

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[1] *Vide* Medico-Legal Autopsies.

The *external* inspection of the body may be of material assistance in clearing up a case of supposed poisoning. For example, stains of the mineral acids may be noticed about the mouth, cheeks, tongue, and fauces, as well as on the clothes of the person. Occasionally the odor of certain poisons is noticed on the body, being much strengthened on opening the corpse. Still, there are no external appearances upon which safe reliance can be placed, as the effects of the acids just mentioned might have been occasioned after death.

Among the post-mortem signs usually presented in poisoning may be noted redness, ulceration, softening of the mucous membrane of the stomach and intestines, and perforation.

The *irritants* act mostly upon the stomach and intestines, setting up irritation, inflammation, and corrosion, and occasionally ulceration, perforation, and gangrene. The coats of the stomach or other viscera may be thickened or thinned and softened. On the other hand, the *narcotic* poisons present no well-marked post-mortem appearances. The *narcotico-irritants* may affect the brain or the alimentary canal, or both. Occasionally, both the irritants and narcotics produce fatal results, without presenting any very decided changes in the body, and the proofs of the existence of the poison must be searched for elsewhere, or by other methods.

Redness.—This is one of the most common post-mortem signs arising from the administration of the irritant poisons. It is also a resultant of many diseases.

Irritant poisons produce redness of the mucous membrane of the stomach and small intestines, which is also attendant in many instances of violent death, such as hanging, strangling, suffocation, and drowning.

The congestion is at first of a deep crimson hue, which rapidly assumes a brighter color when exposed to the atmosphere. The whole mucous membrane of the stomach or intestines may be of this color, or it may be confined to patches, dots, or striæ, irregularly spread over the various surfaces. Its usual site is at the larger extremity of the stomach, although it is sometimes noticed at the smaller end. On the other hand, the congestion may be confined to the folds and prominences of the mucous membrane.

In the healthy state the mucous membrane of the stomach is pale or white, or of a light-pink color. During the progress of digestion it becomes somewhat reddened, which condition has been noted even after death.

Transudation of blood from the liver or spleen has produced a deep livid color in the stomach. A somewhat similar change has been noted in the intestines, as a resultant of post-mortem gravitation of blood. These differences, however, are not likely to be mistaken for the action of irritant poisons.

As a similar redness may be occasioned by disease, it will be necessary to be familiar with the nature of the symptoms preceding death, or have some chemical demonstration of the presence of the irritant poison in the body. Redness of the mucous membrane of the stomach may be caused by acute gastritis, gastro-enteritis, etc.

Putrefaction alters the redness of the mucous membrane of the stomach when circumstances are favorable to this process. This renders it difficult to discern the cause of the discoloration. No definite rule can be advanced regarding the length of time during which the redness of the stomach will be recognizable, nor as to the changes produced by the process of putrefaction. Taylor refers to two cases of arsenical poisoning where the appearances of inflammation were apparent in the stomach and duodenum twenty-eight days after burial; and in another instance of poisoning by the same substance nineteen months after interment.

As evidence of poisoning, redness can be relied upon as a safe sign only when the origin of the discoloration is known, else it would be unsafe to trust to this appearance alone, unless the poison were detected.

Ulceration.—This pathologic change is sometimes the result of irritant poisoning. The mucous membrane of the stomach is usually found to be in a state of disintegration,—that is, the membrane is removed in small circular patches. In the ulceration caused by poison the resultant redness is diffused; the reverse is usually the case when due to disease. Ulceration from the effects of various maladies is of more frequent occurrence than that arising from the action of poisons.

In determining the cause of ulceration due to the irritants, the history of the case previous to death will be of great assistance.

The difference between ulceration and corrosion is this: ulceration is a vital process,—that is, the substance of the part is removed by the absorbents as a result of inflammation. Corrosion is a chemical action, the immediate contact of the poison being necessary for the destruction of the parts, which are decomposed and enter into combination with the corrosive matter itself. Ulceration is slow in establishing itself, while the corrosive action of a poison is often of instant occurrence.

Softening.—Softening of the coats of the stomach may be the result of poison or of disease. Corrosives are the most frequent cause of this condition, and it is important to note that their action will be observed also in the mouth, fauces, and œsophagus, while in softening from the effects of disease alone, the change will be confined to the stomach, most frequently at its cardiac extremity.

Cases are on record where the appearance of the stomach was of a hardened instead of a softened nature.

Softening of the stomach is by no means characteristic of poisoning. Innumerable instances go to show the truth of this assertion. If produced by the action of the irritant poisons, it is usually accompanied by other decided marks of their action, the absence of which would negative all suspicion of poisoning.

Perforation.—As with softening and other pathologic changes observed in poisoning, perforation may be the result of disease as well as of poison.

Perforation may be the result of corrosion or ulceration. Where the strong mineral acids have been taken, the perforation will be large and

ragged, the margins being soft and friable. After perforation the poison is readily detected in the abdominal cavity. Perforation from ulceration due to the irritants is of rare occurrence, and is usually observed where arsenic and other irritant poisons have been taken.

In the perforation caused by poisoning, the pain experienced by the patient previous to death is rather of an insidious nature, coming on gradually ; it increases slowly. In disease its appearance is suddenly noticed soon after partaking of a meal. The vomiting due to irritant poisoning is excessive and the purging almost constant. In disease it is frequently absent, or, if present, it is slight, the vomit consisting of the material swallowed. In the latter case the aperture is small, of an oval or rounded form, and the edges smooth, while in poison cases it is large and ragged.

Death takes place most frequently in from eighteen to thirty-six hours, when the aperture is the result of disease. The average period of death in arsenical poisoning and other irritants is the same ; but arsenic does not cause perforation of the stomach within twenty-four hours. Therefore, in differentiating between perforation produced by poisoning and that caused by disease, it is necessary to be familiar with the history of the case, the presence or absence of poison in the stomach, together with the other characteristic marks of both poison and disease. In perforation from disease the symptoms and death are referable to peritonitis.

Occasionally the coats of the stomach are rendered *soft* by spontaneous changes. This change usually occurs at the cardiac extremity. Such extravasation is very likely due to post-mortem changes, the stomach undergoing a process of solution. The solvent action of the gastric juice is a supposed cause of this condition. The diaphragm, liver, spleen, and other viscera are sometimes found to have softened spontaneously.

This spontaneous or gelatinized form of post-mortem perforation is most commonly situated at that portion of the stomach which lies to the left of the cardia. In form it is irregular ; its size is large, and the margins of the perforation ragged and pulpy. The mucous membrane is not inflamed, though an occasional slight redness, with black striæ near the softened parts (coats), is frequently observed. This form of perforation may be mistaken for that caused by the action of corrosives ; but the symptoms during life, the detection of the poison after death, and the evidences of changes produced in the mouth, fauces, and œsophagus will be sufficient to enable the pathologist to reach a correct result.

Evidences from Chemical Analysis.—The chemical detection of a poison is, in many instances, a very difficult matter, and the physician must be well skilled in the minutiæ of the various processes adopted.

In making a chemical analysis in case of poisoning, it is important that the physician acquaint himself as to the nature of the symptoms, as well as of the post-mortem changes, as such knowledge may be of material assistance in determining the nature of the ingested poison.

Evidences derived from chemical analysis are generally regarded as the

most positive, although satisfactory proof of death by poisoning is afforded, in some instances, without this method. If the symptoms, post-mortem changes, effects of the poison on animals, etc., are perfect, then this particular line of proof is unnecessary.

There are certain poisons which have no chemical test, especially those of the animal and vegetable kingdoms.

The evidence of poison in the stomach does not necessarily prove that death resulted as a consequence; and, were the usual symptoms, lesions, moral proofs, etc., absent, might justify the suspicion that the poison gained entrance into the body after death. (*Vide* Embalming.)

The discovery of the absorbed poison in the liver, spleen, kidney, etc., is far stronger evidence of the existence of poisoning than its mere presence in the stomach, since, in the latter instance, it might possibly have been introduced after death; and the fact must not be overlooked that it is quite possible for a liquid poison, after its introduction into the stomach or rectum of a corpse, to pass through the coats of the viscus, when the conditions are most favorable to osmosis, and thus come in contact with adjacent organs, penetrate them, and leave evidence of its presence. The injection of arsenic or corrosive sublimate into the blood-vessels, as is done in the process of embalming, may occasion similar results. These are important facts to keep in mind, for the reason that suspicion of poisoning might be aroused, even months after interment; and when the body is disinterred and opened, marked signs will be shown to exist in the different organs which might be mistaken for *absorbed poison*.[1]

In every case of chemical analysis the utmost care and accuracy on the part of the toxicologist is essential for the facilitation of the process. The purity of his reagents must be carefully ascertained, else the suspected substance may fail to respond to any one of the tests applied.

The first step to pursue in the examination of suspected matters is to note the general appearance, the odor, and the color. The *odor* may be useful in indicating the presence of various poisons, such as alcohol, prussic acid, opium, etc. The *color* may suggest the salts of copper, parts of insects, such as cantharides, or certain preparations of arsenic with various coloring-matters. The *general appearance* and condition of the various organs may assist the examiner in determining the method by which the poison was introduced into the system, the kind of food or drink used to conceal it, and so on. These organs should be carefully examined, and the facts accurately noted and preserved for future reference in the course of the analysis.

The failure to find poison in those instances where all the other evidence substantiates the fact that poison had been taken, may be due to one or more of the following reasons: (1) The poison may have been vomited before death, or eliminated through the fæces and urine. (2) Elimination may occasion loss of the poison, this being particularly the case where the

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[1] *Vide* p. 12.

dose is small and death protracted. (3) The poison may be of such a nature as to be undiscoverable by chemical tests. (4) The poison may be unrecognizable on account of its having been decomposed in the blood or tissues before or after death. This is more particularly the case with the organic substances. The mineral poisons are not decomposed after death, although their chemical constitution may be subject to change. (5) The alkaloids of putrefaction (ptomaïnes), in the case of the vegetable poisons, which they strongly resemble, may render detection of the real noxious substance impossible. (*Vide* Ptomaïnes.)

The *toxicological examination of the contents of the stomach and intestines*, or other viscera, should be conducted with great care. Only one portion of the suspected material should be examined at a given time, reserving the other portion for future experiments. To the naked eye alone should not be intrusted the entire search in the examination of the suspected matters of the stomach, etc., but it should be aided by the use of a magnifying glass of some power. In this way characteristic crystalline forms, etc., may be discerned.

Suspected poisons ought to respond to all the chemical tests ; therefore, the object of the toxicologist is to secure the materials which he has to examine in as pure a condition as possible, else there might be doubt as to the results of the various tests employed. The bulk of the liquid to be examined is reduced by evaporation, since a minute amount of poison present might not be responsive to the usual tests. At times the material may be separated by simple filtration ; or, in order to separate colloid substances from crystalloids, the process known as dialysis is employed. In the case of volatile bodies, such as phosphorus, prussic acid, chloral hydrate, alcohol, chloroform, etc., distillation is employed to secure them in as pure a state as possible. But in the case of the poisonous alkaloids other methods must be employed.

For the destruction of organic matter in the search for an inorganic poison, such as arsenic, the process suggested by Fresenius is most frequently adopted. Its essentials are as follows : The substance to be tested is finely comminuted, and boiled with about one-eighth of its bulk of pure hydrochloric acid, crystals of potassium chlorate being added from time to time until the solids are reduced to a straw-colored fluid. A hydrogen sodium sulphite is then added to this fluid until a distinct odor of sulphurous acid is given off. Sulphuretted hydrogen is then passed through the fluid for some hours, precipitating most metallic poisons in the form of sulphide. The precipitate is then collected and reserved for further test.

In the separation of the poisonous alkaloids from complex mixtures the use of the various methods for testing introduced by Stas, Roger and Girdwood, and Uslar and Erdmann, which are practically the same, is recommended.

In Stas's method ether is used as the solvent ; in Roger and Girdwood's, chloroform is employed ; while in the Uslar and Erdmann method alcohol is used.

Stas's Process for separating Alkaloids.—A solution of the contents of

the stomach, or of the solid organs reduced to fine shreds, is made by digesting them with water or acidulated alcohol, and then subjecting the whole to filtration. Ether is next added to the filtrate, in order to remove the oily matters. The ether is then removed, and the aqueous solution neutralized by the addition of soda or potash. Finally, the alkaloid is separated by ether, when it will probably be left behind in a condition fit for further testing.

With the exception of crystalline morphine, the pure alkaloids are soluble in ether, while the salts of the alkaloids are insoluble, although they are soluble in water and alcohol.

There are many modifications of the Stas process. For example, the substance to be tested is acidulated with hydrochloric acid and heated over a water-bath for an hour or more. The mixture is then filtered, continuing the process until a pure product is the result, which is neutralized by the addition of hydrogen sodium carbonate. The freed alkaloid is then *taken up* by shaking it with ether or chloroform, put in a well-corked tall test-tube, and set aside. The ether or chloroform is separated by means of a pipette and allowed to evaporate, when the alkaloid remains for further purification or testing.[1]

Other methods employed by the skilled toxicologist in detecting even minute traces of poison exist. Combinations are formed with other elements, revealing the poison in the form of solids, liquids, or gases. Others are arrayed in varied colors, in crystalline shapes, or volatilized in flame, and viewed by the achromatic or apochromatic lenses of the microscope, or their incandescent vapors through the prisms of the spectroscope. For example, the existence of metals is indicated by brilliantly tinted and sharply defined lines as they are presented in front of the narrow slit of the spectroscope, even infinitesimal traces being accurately noted.

The microscope is a delicate and essential adjuvant in many toxicological examinations. By its use the expert is enabled to recognize characteristic crystalline forms and to present them to the court and jurors. Not only is this possible, but by the aid of chemical reactions applied to various specimens the examiner is enabled to determine, by the changes they effect, the identity of the poison sought.

The great advances made in electricity have contributed the mysterious power of this fluid in toxicological analyses, as is exemplified in the production of ozone for the purple-color reaction for strychnine, or in evolving hydrogen from distilled water for the "Marsh test." (Doremus.)

Evidences from Experiments on Living Animals.—In those cases where the poison cannot be identified by any of the previously mentioned methods, the introduction of the suspected substance into the body of a living animal is a resource marked with decided accuracy. For example, in a recent instance of supposed morphine-poisoning the analysis lasted for three months, at the end of which time a little of the substance abstracted from

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[1] *Vide*, also, the various alkaloidal poisons.

the exhumed stomach was introduced into a frog, with the result that it exhibited all the symptoms of morphine-poisoning as shown by a second frog, which was subjected to an inoculation at the same time with pure morphine obtained in commerce. It is well to remember in connection with these experiments that the secretions of the alimentary tract may become poisonous through disease, and in this manner affect the animal inoculated. On the other hand, certain animals may eat poisonous plants, which, when swallowed by man, may be fatal in their action ; poison may be thus introduced into the human system by eating an animal that had previously fed upon such plants.

Post-Mortem Imbibition.—The possibility of the post-mortem absorption of poison into the viscera of the human subject leads to the necessity of determining whether the poisonous substance was introduced into the system previous to or after death. The experiments carried on by Orfila proved the possibility of post-mortem imbibition. Dr. G. B. Miller injected strychnine into the stomach of a dead rabbit, with the result that it penetrated by imbibition into the liver, spinal cord, and bladder. Sutton, of Philadelphia, and Vaughan, of Michigan, performed various experiments in this line, showing that when a solution of arsenic was injected into the stomach of a dead animal, it could, after a reasonable lapse of time, be detected in the brain, spinal cord, and cranial bones. (*Vide* Embalming.)

Orfila observes that after imbibition the poison is more likely to be found on the exterior parts of an organ, while in genuine poisoning the poison is deposited in the interior of the organ. This is an important point to remember, since the detection of real poisoning by *chemical analysis* is one of the strongest proofs as evidence. (*Vide* p. 25.)

Circumstantial Evidence.—Among the various circumstances often of service in establishing the fact of an administration of poison is the behavior of suspected persons. Any suspicious acting on the part of those surrounding the patient should be noted. Ascertain, if possible, whether the accused person had a motive in administering poison, whether he purchased or possessed poison, whether he was in the habit of giving the poisoned individual his meals, and whether he prevented the deceased from obtaining medical aid. Did the accused assume the exclusive duty of disposing of vomited matters? of administering medicine? Did the accused express an opinion as to the likelihood of a speedy death? Did he object to an autopsy, and was the burial of the poisoned person premature? Was the conduct of the accused suspicious after the death of the deceased? Did he venture a false history of the illness?

There is no person so well fitted to make note of these points as the physician, and the application of his scientific knowledge to the detection of crime might be the means of bringing a murderer to the bar of justice.

In the recent trials of the wife-poisoners, Carlyle Harris and Dr. Robert W. Buchanan, many of the above series of evidences were so many links welded to a chain of proof that conviction and execution were rapid results.

Medico-Legal Questions.—There are certain questions of a medico-legal nature in all criminal cases of poisoning that the analyst must be prepared to meet when the case is presented for trial. Some of these questions are: (1) Could the illness or death of a person be due to poison; and, if so, what is the nature of the poison? It is rarely possible for the toxicologist to exhibit the poison that caused death, as the *corpus delicti*. He can, however, demonstrate the chemical tests. The mineral poisons must be exhibited, together with their chemical reactions. (2) Would such a poison, administered in sufficient quantity, cause death? At what period was the poison administered? This latter query leads to the consideration of the symptoms,—viz., the time of their first appearance and their duration. (*Vide* Evidences from the Symptoms, p. 16.) (3) Is it possible for such a poison to disappear entirely from the body without leaving any trace? Complete elimination may take place, provided the person has survived long enough. (*Vide* Elimination of Poisons, p. 13.) Might the poison detected in the system be ascribed to any other source than that due to criminal poisoning? Poison found in large quantities and in the absorbed state in the organs would furnish a negative reply to this question; although the fact must not be lost sight of that minute quantities of a poison might be present in the body as the result of medicinal or accidental administration. Further, post-mortem imbibition is possible. (*Vide* Post-Mortem Imbibition and Embalming.) (4) Can poisoning be feigned? The answer must be affirmative. (*Vide* Feigned Diseases.)

CHAPTER III.

DUTIES OF THE PRACTITIONER IN CASES OF POISONING.

Rules to be followed in Poison Cases—With Respect to the Living Person—Inspection of the Body—The Exhumation of Bodies—Disposal of the Viscera—Identity of Vomited Matters, etc., from the Deceased Body—The Use of Notes—Medico-Legal Reports.

WHEN a practitioner is called to a case of supposed poisoning, his first duty, of course, must be to prolong or preserve life. But if he reaches the patient too late to dispense his services, a second duty devolves upon him in those cases where a suspicion of criminal poisoning has been aroused. This second requirement on the part of the physician is to see that justice is done. The neglect of this duty, or carelessness in its performance, might stop instead of setting in motion the wheels of justice. In addition to the ordinary rules framed for the guidance of physicians in dealing with poison cases, the following points are appended for his careful attention:

I. *Symptoms.*—Ascertain the exact period at which the symptoms were first observed to occur after the ingestion of food or medicine. Inquire as to the time of their occurrence, the order of their progression, and the nature of the symptoms from the beginning of the sickness onward.

Ascertain whether there was any remission or intermission in their course ; whether they became more and more severe in their character until death ; or whether their violence was emphasized after a particular meal, or after the administration of any particular article of food or medicine. Note the odor, color, and acid or alkaline reaction of vomited matter, if any ; also the quantity, and if possible base these observations upon the matters first ejected. Observe whether the patient was in the recumbent position or not when the vomiting occurred ; if in the erect or sitting posture, parts of the patient's clothing will very likely be stained with the ejected matters.

II. *Articles of Food and Medicine.*—Ascertain the exact time, if possible, at which any substance was last taken by the patient ; also its nature, together with that of all the various articles of food used at a meal. Inquire whether the food was taken by more than one person ; and, if so, whether the others suffered poisonous effects.

III. *Death of the Patient.*—When fatal results follow the ingestion of poison, the physician must make note of the following : the time of death, and the attitude and position of the body. Pay particular attention to the condition of the clothing of the deceased ; also to surrounding objects, etc.

Inspection of the Body.[1]—Carefully examine the external appearances of the body to ascertain the state of the countenance, condition of the general surface of the body (livid or pallid ?), the presence or absence of *rigor mortis*, and the warmth and condition of the room in which the person died.

If the person was found dead, then attempt to ascertain when the deceased was last seen alive ; also note any circumstances which might lead to a suspicion of homicide or suicide.

The Exhumation of Bodies.—In connection with criminal poisoning, any suspicious conduct or misbehavior on the part of suspected persons would warrant the disinterment of a corpse for the purpose of satisfying the authorities as to the suspicion of poisoning being entertained or not. This was the means of causing the arrest of Dr. Buchanan, the recently electrocuted wife-poisoner.

Inspection of a body is often made long after interment. The expectation of detecting certain of the mineral poisons in the organs is much strengthened so long as the coffin is found in good condition. However, in some cases decomposition has advanced to such a stage as to preclude the possibility of securing pathologic evidence. When such is the case inspection is usually limited to the abdominal viscera. The stomach and duodenum, with

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[1] For the details respecting the mode of performing an inspection of the body, the reader is referred to the chapter on Autopsies.

ligatures applied to each, together with the liver and spleen, should be removed for separate analysis. (*Vide* Medico-Legal Autopsies.)

When the coffin is not entire, and when decomposition is so far advanced as to permit mixture of the earth with the viscera, it has been suggested that portions of both earth and coffin be submitted to analysis. The advisability of this procedure is questionable.

After a careful analysis of the viscera is made, and no evidence of poison is apparent in any one organ, it is unlikely that it will be discovered in any other part of the body.

When the body of a deceased person is exhumed, it is important that its identification be absolute, else all other evidences that might be elicited would *fall flat*, and be of no material benefit.

Disposal of the Viscera.—With the view to preserving various portions of the body for subsequent examination, extraordinary care must be exercised in their removal, else serious errors in the analyses might occur.

In cases of suspected poisoning, the alimentary canal is the most important organ to preserve. It is usually removed in separate portions. (*Vide* Medico-Legal Autopsies.) Portions of the liver, if not the entire organ, should be preserved for the toxicologist. Frequently it becomes necessary to examine the brain, spinal cord, thoracic viscera, spleen, kidneys, etc., and, in women, the uterus and vagina. When such is the case, portions or the entire organ should be set aside for analysis.

When all precautions have been taken to secure the organ or organs in as pure a condition as possible, the part or parts are transferred to jars, which are then sealed, numbered, labelled, and initialled, to facilitate identification, as well as to avoid subsequent confusion.

It is almost unnecessary to add that no preservative or other fluid is to be employed.

The Identity of Vomited Matters, etc.—In a case recited by Taylor the evidence of the presence of poison in the contents of a stomach was *thrown out* in a court of law on account of the negligence on the part of the physician who performed the autopsy in placing the stomach contents in a jar secured from a person known to have dealt in poisons. Satisfactory proof of the cleanliness of the vessel was found wanting, and the benefit of the doubt was properly given to the suspected person.

Another important point to recollect is that the identity of a substance, such as vomited matter or other liquids, must be preserved, else such evidence will be rejected.

The Use of Notes.—It is very important that all the observations made by a physician in poison cases be committed as speedily as possible to writing. These notes should embody everything pertaining to symptoms, post-mortem appearances, and the results of the chemical analysis.

In courts of law the use of notes is admissible only to assist recollection, not to convey information ; if used for the latter purpose, the evidence is inadmissible.

Medico-Legal Reports.—One of the duties of the medical jurist is to draw up a report of the symptoms, the post-mortem appearances, and the results of the chemical analysis.

Facts should be stated in plain language ; and if it becomes necessary to introduce technical terms, their meaning should be parenthetically expressed, so as to make them easily intelligible to non-professional persons.

Medico-legal reports should only state facts, not opinions and inferences. The conclusions of the examiner should be reserved for the latter part of the report.

CHAPTER IV.

CLASSIFICATION OF POISONS.

THERE is nothing more difficult in toxicology, as in every other branch of natural science, than to exhibit with exactitude a satisfactory classification of poisons, insomuch that the definite limits to their action are boundless.

Some writers upon the subject of toxicology have grouped poisons according to their source ; thus, a sort of *natural-history system* is the result, and is expressed by the two classes of *inorganic* and *organic* poisons, or by those of *mineral*, *vegetable*, and *animal* poisons.

Another classification, based on the effects of poisons upon the healthy animal system, is appropriately mentioned as the general arrangement of nearly all toxicologists.

The arrangement of the poisons to be treated of in this book is founded upon the latter classification, a grouping simply according to the *physiological* action of the poisons. Under such circumstances a scheme somewhat similar to the following, however imperfect it may be, will be of great assistance to the toxicologist when the action and influence of a poison upon the system are sought.

All poisons are classed as *irritants* (simple and specific) and *neurotics* (cerebral, spinal, and cerebro-spinal).

I. IRRITANT POISONS.—The group of *irritants* comprehends all poisons which by contact produce an irritation or inflammation of the alimentary canal.

The *symptoms* are burning pain in the œsophagus and stomach ; nausea and vomiting, with altered blood in the matters ejected. The thirst is intense, and there usually exist pain in the abdomen and cramps in the stomach and other parts of the body. There is straining and blood in the stools. Depression of the vital powers is great, and in fatal cases death follows from exhaustion.

The *post-mortem* signs are more or less inflammation of the mucous membrane of the alimentary tract. Occasionally there may be ulceration, per-

foration, and gangrene. When these poisons are administered in a diluted state they may be incapable of destroying the tissues directly, but their indirect action, occasioned by inflammatory changes, may do so. Poisons acting in this manner are classified as *simple irritants*, though they possess the power of destroying life by virtue of their secondary effects.

Specific irritants are not only capable of causing inflammations of a local character, with their secondary effects, but are also possessed of remote specific properties. Arsenic, for example, is such a poison.

Irritant poisons are further separated according to their source, and are grouped as mineral, vegetable, and animal poisons, the former (mineral) being subdivided into non-metallic and metallic.

Certain of the irritants are properly classified as *corrosives*. These irritant poisons destroy the bodily textures by contact, occasioning fatal results as a consequence of their chemical action. Diluted corrosives are simple irritants.

II. **NEUROTIC POISONS.**—These poisons include those substances whose effects are specific, and are referable to the great nervous centres, the brain and spinal cord.

They are subdivided into *cerebral* (narcotics and anæsthetics), *spinal* (sometimes called tetanics), and *cerebro-spinal*, which act upon the brain and spinal cord (deliriants, depressants, asthenics).

Such a diverse group must be somewhat imperfect, and its analysis, of course, difficult, as the boundary line between the various classes and orders of poisons cannot be marked out with any degree of accuracy.

The neurotic poisons are derived from the vegetable kingdom, and exhibit substances like strychnine, atropine, opium, chloral, Calabar bean, prussic acid, tobacco, aconite, etc.

The *symptoms* occasioned by the poisons which act on the nervous system are giddiness, headache, drowsiness, stupor, delirium, coma, convulsions, paralysis, etc.

Diseases which resemble the Action of Irritant Poisons.—The diseases which simulate the action of these poisons are severe diarrhœa, malignant cholera, colic, gastritis, enteritis, obstruction of the bowels, rupture of the stomach or of the intestines, etc.

Diseases which resemble the Action of the Neurotics.[1]—Various symptoms of certain affections are strikingly similar to those occasioned by the neurotic poisons. Thus, delirium with spectral illusions or convulsions results from the poisonous administration of belladonna. Sometimes, as in strychnine-poisoning, there is tetanus. Coma follows opium or carbolic-acid-poisoning, and syncope digitalis.

It is well to remember that diseases of the brain and spinal cord, likely to be mistaken for the effects of narcotic poisons, are rather of an insidious nature in their progress, and might occasion suspicious symptoms. Atten-

[1] *Vide* Diseases simulating Poisons.

tion to the history, etc., will usually enable the physician to reach diagnosis.

The following tabular arrangement exhibits the subdivisions poisons, classified according to the *Irritant* and *Neurotic* divisions.

TABLE OF CLASSIFICATION.

CLASS I.—IRRITANTS.	*Order* *Irritants proper.*			Sulphuric acid.
				Nitric acid.
				Hydrochloric acid.
				Potassa.
				Soda.
				Ammonia.
				Nitrate of potash.
				Chlorate of potash.
				Bitartrate of potash.
				Alum.
				Sulphate of potash.
				Chlorinated soda and potash.
				Salts of barium.
	Order 2. *Specific Irritants.*	Mineral.	Non-metallic.	Ph
				Iod
				Br
				Ch
			Metallic.	Ar
				An
				Me
				Le
				Co
				Zin
				Bis
				Ti
				Iro
				Ch
		Vegetable.		Oxalic acid.
				Tartaric acid.
				Acetic acid.
				Carbolic acid.
				Croton oil.
				Elaterium.
				Castor-oil beans.
				Savine.
				Hellebores.
				Yellow jasmine.
				Poisonous mush
		Animal.		Cantharides.
				Poisonous anima
				Poisonous fish.
				Decayed meat, e

TABLE OF CLASSIFICATION—*Continued.*

ASS II.—NEUROTICS.	*Order 1.* *Cerebral.*	Narcotics.	Opium.
			Morphine.
			Alcohol.
		Anæsthetics.	Ether.
			Chloroform.
			Chloral hydrate.
	Order 2. *Spinal* (*tetanics*).	Nux vomica.	
		Strychnine.	
		Brucine.	
	Order 3. *Cerebro-Spinal.*	Deliriants.	Belladonna.
			Atropine.
			Stramonium.
			Hyoscyamus.
			Solanum.
		Depressants.	Tobacco.
			Nicotine.
			Lobelia.
			Lobeline.
			Hemlock.
			Coniine.
			Aconite.
			Aconitine.
			Calabar bean.
		Asthenics.	Prussic acid.
			Cyanide of potassium.
			Oil of bitter almonds.
			Cherry-laurel water.
			Nitro-benzole.
			Digitalis.
			Digitalin.
			Cocculus indicus.
			Picrotoxin.
			Cytisine.

CHAPTER V.

CLASS I.—IRRITANT POISONS.

POISONING BY THE MINERAL ACIDS.

SULPHURIC ACID.

General Remarks—Symptoms—Treatment—Post-Mortem Examination—Toxicological Examination—Detection of Stains on Clothing—Tests.

SULPHURIC ACID—*oil of vitriol*—is used in the arts and manufactures for a great variety of purposes, and is one of the most useful acids known. In its concentrated state it is an oily-looking liquid, of a light-brownish color, intensely sour, and has a decided acid reaction. Its specific gravity is 1.845.

Sulphuric acid is often the cause of death in infants and young children. Not infrequently men, while under the influence of liquor, are poisoned by it; and its employment as a disfiguring agent, by being thrown over the person, is well known. When the latter is the case the parts of the body stained by the acid are at first of a white color, but afterwards assume a dark-brown or blackish hue.

Homicidal deaths are more frequently the result of this acid than of any of the others, and its dangerous qualities are proportionate to its degree of concentration rather than to the quantity administered.

The smallest *fatal dose* of the concentrated acid for an adult is one drachm (recovery has taken place after two ounces); for an infant, one-half drachm.

The *shortest period* at which *death* takes place is one hour and three-quarters; its fatal effects are very rapid where the rima glottidis is attacked, as suffocation supervenes. The *average* time at which fatal results occur is from sixteen to twenty-four hours.

It is believed by some authorities that sulphuric acid is absorbed into the circulation and eliminated by the secretions, though it has not been discovered in the urine during life.

This acid has the power of preventing putrefaction for a long period. (Casper.)

Symptoms.—When the acid is taken in its concentrated form, the symptoms appear almost immediately. There is violent pain in the mouth, throat, œsophagus, and stomach. The pain is frequently so severe that the body is bent.

These signs are followed by vomiting, the latter being accompanied by the discharge of shreds of tough mucus, altered in color, and of a coffee-ground-like matter, containing blood and portions of the lining membrane

of the stomach. The mouth is excoriated and the surface of the tongue white; after a time this color changes to gray or brown. Salivation is profuse, and the cavity of the mouth is filled with a thick, viscid mucus, which is composed of saliva and the membrane of the oral cavity.

After a short space of time great prostration ensues, the eyes are sunken, the face is pallid, the skin cold and clammy; the circulation is impaired, and the breathing is extremely difficult, owing to the swelling and excoriation of the fauces and larynx.

There is generally great thirst, which cannot well be satisfied. Obstinate constipation may exist. The patient appears to be in the greatest agony, and convulsive movements are frequently observed. At other times the patient passes into a semi-conscious condition and stupor.

Death takes place either from collapse or from perforation of the stomach. On the other hand, it may occur very rapidly from asphyxiation.

Patients frequently recover from the immediate effects of the poison, but they finally succumb to the secondary results, and die from strictures of the œsophagus or stomach, or from perforation of the œsophagus.

Treatment.—Avoid the use of the stomach-pump or tube, for fear of perforation. If the patient can swallow, give diluents and neutralizing agents (powdered chalk, whiting, or pounded plaster, magnesia, etc.) freely. Barley-water, linseed tea, oatmeal gruel, diluted starch, etc., are all useful.

Treat the collapse and other symptoms as they are presented. Tracheotomy has been resorted to for the relief of the excessive dyspnœa.

Post-Mortem Appearances.—The larynx, trachea, and lungs are softened and blackened. The œsophagus is gray or blackish in color, softened, and the mucous membrane separated, coming off in shreds. The stomach is softened or perforated; it may contain a blackish, pulpy fluid, due to altered blood. The contents of the blood-vessels are hard and black.

If perforation exists, the edges of the opening will be dark and ragged, and the adjoining viscera blackened and softened. If life has been prolonged, inflammation of the intestines, peritoneum, etc., may be present.

The skin of the face or surrounding parts, where any acid has fallen, will be corroded and blackened.

Toxicological Examination.—All thick and viscid organic matters should be boiled in distilled water, filtered, and then subjected to the nitrate or chloride of barium test, when a dense white precipitate of the sulphate of barium is formed. This is insoluble in acids and alkalies.

Occasionally the solution contains a soluble sulphate, together with an acid, such as citric, acetic, etc. When such is the case the method of differentiating between this and a solution containing free sulphuric acid is as follows: Acidulate a given volume of the solution with nitric acid, and precipitate with the above-mentioned test. The next process is to evaporate an equal volume of the original solution to dryness (which frees the sulphuric acid), and dissolve the residue in distilled water; filter, and precipitate. The

dried precipitate is then weighed and compared with the other, when, if the result is equal, there was no free sulphuric acid present. But if the weight of the former precipitate is greater than that of the latter, then the excess of weight will show the amount of free sulphuric acid in the first or original solution.

In some instances the chemical analysis alone is not sufficient to detect the poison, and other signs must be looked for in the symptoms, etc. This is generally the case where the acid has been neutralized by the administration of alkaline antidotes, the vomit and stomach containing only sulphates.

Detection of Stains on the Clothing.—Sulphuric acid stains on dark cloth are red or brownish red in color, their moisture being retained for a considerable time. A bright reddish or yellowish stain follows the application of the acid to other colored materials.

Holes burnt into cloth by heated bodies contain no adherent moisture, as is the case when sulphuric acid spends its effects. *Moisture*, therefore, is the distinguishing mark between the effects of heat as produced by a heated body and that of the acid. The charred hole in the former case is always dry, while in the latter the moisture is adherent.

To detect the acid on clothing, the parts affected should be cut out and boiled in distilled water, and then tested with any soluble barium salt.

Tests.—(1) Sulphuric acid is known by its oily appearance, its weight, its action on organic matters (which it chars), its energetic action when mixed with water, and the freeing of sulphurous acid fumes when heated with metallic copper, mercury, wood, or charcoal.

(2) The diluted acid[1] is recognized by the action of any of the soluble barium salts upon it, which throw down a white precipitate, which is insoluble in nitric acid. (It is well to recollect that neutral sulphates give similar results, when treated with nitrate of barium, as the free acid.) To distinguish between them, a drop of the suspected solution is evaporated to dryness, when, if it consisted of free acid, no residue is found; but if a sulphate be present, a saline residue will be left. Again, where the solution consists of both the free acid and some soluble sulphate, the application of the following test will clear up the matter: Warm the liquid to be tested, and add finely powdered carbonate of barium, when a precipitate of free sulphuric acid will be formed, showing that the newly formed sulphate of barium represents the free acid present.

(3) To the diluted acid a small portion of veratrine is added, and carefully evaporated to dryness, when a crimson-purple color is formed. This test produces no effect upon a sulphate.

Quantitative Analysis.—This is estimated as a sulphate, as follows: Carefully wash in hot water, with a trifle of hydrochloric acid added, the precipi-

[1] A white precipitate with the barium salts is also produced by other acids, such as oxalic, phosphoric, carbonic, etc.; but they are readily dissolved by nitric or hydrochloric acid, while the sulphate remains unaffected by them.

tated sulphate of barium ; then filter, dry, and weigh ; 100 parts of the sulphate are equal to 42.02 parts of monohydrated sulphuric acid.

NITRIC ACID.
(Aqua Fortis.)

This powerful substance is of a yellow or orange color, with a specific gravity of 1.35 to 1.45. Its color is due to peroxide of nitrogen, with which it is mixed.

Nitric acid is occasionally administered or taken in poisonous doses, but cases of death from its employment are rare.

Two drachms is the smallest recorded quantity required to produce fatal results, and one hour and three-quarters (average within twenty-four hours) the shortest period at which death has taken place.

Less than two drachms of this substance will prove disastrous if the trachea be involved.

Symptoms.—When the acid is in its concentrated state, the symptoms do not differ materially from those caused by sulphuric acid, with the exception of the pain, which is less severe, and the color, which is at first white, then yellow or orange, and finally brownish red. The vomited matters are yellow or brown.

The fumes of nitric acid are extremely poisonous, the symptoms therefrom manifesting themselves within a short period ; they develop into acute inflammation of the air-passages.

The chemical action of the poison is likely to produce gaseous eructations. The abdomen is usually swollen and exquisitely tender ; in some cases the pain is confined to the fauces. The enamel of the teeth is liable to destruction.

The pulse is small, frequent, and irregular, and the act of deglutition extremely difficult, and may give rise to severe vomiting. There is obstinate constipation, etc.

Treatment.—Avoid the use of the stomach-pump or tube. Subsequent treatment in all respects similar to that recommended for sulphuric acid.

Post-Mortem Appearances.—The most characteristic appearances after death are the discoloration of the lips, tongue, and inside of the oral cavity. The mucous membrane of the digestive tract is eroded and softened. The stomach is softened, though rarely perforated. It may be altered as regards color in the following way : By the action of the acid on the mucous membrane, producing a yellowish hue; on the blood, a blackish; and on the bile, a green or brownish color.

Toxicological Examination.—The contents of the stomach, etc., should be tested with litmus paper, as the antidotes administered, being of an alkaline nature, may have neutralized the acid.

Any viscidity of the liquid must be counteracted by the addition of a sufficient quantity of distilled water, and boiled for fifteen minutes. This is

then filtered,[1] and, if acid, first tested by subjecting part of it to the influence of copper filings. A solution of weak carbonate of potassium is added for neutralization purposes, and crystallized by evaporation. The crystals should be washed with alcohol to remove impurities, and tested by the methods described in the next paragraph.

When the matters examined are not acid, they having been neutralized by alkalies (carbonate of lime or magnesia), the process to follow is to boil the insoluble nitrates of these earths with potassium carbonate or liquor potassæ, and filter, crystallize, and test as before.

Examine the urine for nitric acid. This is done by distillation with sulphuric acid and neutralization with carbonate of potassium.

To examine the *tissues*, proceed as follows: Secure four test-tubes, and put from twenty to thirty drops of a mixture composed of equal parts of sulphuric acid and water into each tube. Now add a little brucine to the first tube, when no change will be noticed; but if a small piece of the tissue to be examined is added, and nitric acid be present, the mixture will assume a blood-red color.

To the second test-tube a trace of sulphate of indigo is added, with the same result as that shown by test-tube number one, until a piece of the tissue is placed in the mixture, when, if nitric acid be present, the color will at once disappear.

A few copper filings and a piece of tissue are added to the third test-tube and boiled, when, if nitric acid be present, the ruddy-brown fumes evolved will strike a blue color with white paper moistened with a solution of iodide of potassium and starch.

To the last test-tube a solution of the sulphate of iron is added: if nitric acid be present, when the tissue is placed in the tube, the mixture will assume an olive-brown color. (Woodman and Tidy.)

Detection of Stains on the Clothing.—To examine a piece of cloth or other fabric, it is only necessary to soak it in warm distilled water. If the solution is acid, it should be neutralized with the carbonate of potassium and the resulting crystals treated by the methods above mentioned. The stains are of a yellowish color, distinguishable from those of iodine and bile by the intensity of the acid when a weak solution of potassa is applied.

Tests.—(1) The *concentrated* acid is recognized by its yellowish stains, forming picric or carbazotic acid; by its evolving ruddy-brown fumes when exposed to the atmosphere, or with copper, mercury, or silver; by its giving off white fumes with the vapor of ammonia; by its bleaching power with a solution of indigo; by its leaving no residue when subjected to heat in a watch-glass; by its negative action on gold-leaf.

(2) The *diluted* acid is detected by its acid reaction; by the negative action of nitrate of barium or nitrate of silver, proving the absence of sulphuric and hydrochloric acids; by its power of turning morphine or brucine

[1] A slow operation; *dialysis* may be resorted to.

red; by its power in dissolving gold-leaf in the presence of hydrochloric acid.

Quantitative Analysis.—The free nitric acid in solution is discerned by saturating it with recently ignited carbonate of sodium. Every fifty-three grains of the carbonate will neutralize fifty-four grains of anhydrous acid.

HYDROCHLORIC ACID.

(Muriatic Acid. Spirit of Salt.)

This acid has a light-yellow color, due to chlorine, and a specific gravity of about 1.15. It fumes when exposed to the atmosphere, and is but seldom taken or administered as a poison. The commercial acid is frequently contaminated with nitric acid, arsenic, and antimony.

Symptoms.—The symptoms are similar to those occasioned by the other mineral acids. The mucous membrane of the mouth and tongue is gray or white in color. The formation of a false membrane is sometimes observed.

Death has resulted from half an ounce of the acid, manifesting itself within eighteen hours. The shortest period at which fatal results follow the ingestion of the poison is two hours.

Treatment.—The same as that recommended for the other mineral acids.

Post-Mortem Appearances.—The mucous membrane of the œsophagus is found detached, and the interior of the stomach presents blackened or charred ridges, which somewhat assimilate the appearances of sulphuric acid. Occasionally the glottis and larynx present an injected and corroded appearance.

Toxicological Examination.—The contents of the stomach, viscera, etc., are placed in a glass retort, with a sufficient quantity of pure water, and distilled. This latter process (distillation) is carried out on account of the volatility of the acid. The distillation is carried on nearly to dryness. The characteristic test with nitrate of silver is then applied.

Objections to this process are raised, on the ground that hydrochloric acid and alkaline chlorides are natural constituents of the fluids of the alimentary canal. Therefore, if the symptoms and post-mortem appearances are negative, proof of poisoning, on the chemical analysis alone, would not be conclusive, and the detection of the acid after death of no value.

To rectify this the following method is employed: To determine whether hydrochloric acid is present in the free state, or as a chloride, the solid particles of the mixture to be examined should be divided into small particles, and distilled water added. The whole is then boiled for thirty minutes, cooled, and filtered. The liquid is next measured into equal parts, one of which is precipitated with nitrate of silver, after the addition of a trifle of nitric acid. The precipitate is then washed, dried, and weighed.

The second portion of the liquid is evaporated to dryness in a water-

bath, thus freeing all of the free acid ; the residue is dissolved in pure water, and precipitated, as in the former instance, with nitrate of silver. Filter, dry, and weigh as before. The weight of the *first precipitate* (chloride of silver) equals all the *free* and *combined* hydrochloric acid present ; that of the *second precipitate* furnishes only the *combined* acid. The difference indicated by the two weights will give the amount of free acid present in the original solution. (Reese.)

Detection of Stains on the Clothing, etc.—Dark cloth is at first stained a bright-red color ; after some days have elapsed, this color assumes a reddish brown. Hydrochloric acid is frequently employed to remove ink-marks in forgery cases. The examination of stains is conducted after the method already mentioned.

Tests.—The *concentrated* acid is known from other acids by the following tests: (1) By its evolving white fumes with the vapor of ammonia ; by its yellow color ; by its giving off chlorine when heated with peroxide of manganese ; by its power of dissolving gold-leaf in the presence of nitric acid ; by its negative action on mercury and copper.

(2) The *diluted* acid is distinguished by the silver nitrate solution test, which gives a white, curdy precipitate of chloride of silver. This precipitate darkens on exposure to light, is insoluble in boiling nitric acid, but soluble in ammonia.

Quantitative Analysis.—The acid is estimated as chloride of silver. One hundred grains of the chloride of silver are equal to about eighty grains of hydrochloric acid of specific gravity 1.15.

MIXED ACIDS.

The mixed acids are used for commercial purposes,—the *nitro-muriatic* (aqua regia) to dissolve gold, and the *nitro-sulphuric* (aqua reginæ) to dissolve silver. They are sometimes used as poisons.

Sulphate of indigo, a solution of indigo in common sulphuric acid, has also proved fatal in some instances. The symptoms and post-mortem signs are the same as those described under sulphuric acid. The membrane of the mouth has a blue or blue-black color. This color is observed also in the vomit, in the fæces (afterwards green), and occasionally in the urine. Treatment same as previously described.

COMMON EFFECTS OF THE MINERAL ACIDS.

Symptoms.—The symptoms of the three acids (sulphuric, nitric, and hydrochloric) possess certain general characters. There is burning pain in the mouth and œsophagus, which is intensified in the stomach. These symptoms begin at once. Following these signs are retching and vomiting, the latter being a dark-colored liquid, composed of shreds of mucus, together with parts of the mucous membrane of the œsophagus and stomach.

When the poisonous agent has been administered in a spoon, or by other like means, the oral cavity is uninjured ; but when such is not the case, the

lips, inside the mouth, are shrivelled and corroded. The characteristic stains of the acid used are apparent.

Thirst is intense, swallowing difficult or impossible, and the respiratory powers impeded. Constipation exists, and the urine is scanty or entirely suppressed. Great prostration ensues, and the pulse becomes rapid and feeble.

The skin is cold and clammy, the countenance expressive of great agony, and death soon follows. The intellect usually is clear to the last.

Fatal results may follow these acids without their having entered the stomach. They have been introduced into the rectum, vagina, ear, etc., with fatal results.

Recovery from the primary effects of any of these poisons is usually followed, at the end of one or two years, by the secondary results (stricture of the œsophagus, etc.) and death.

Treatment.—The stomach-pump should not be employed. Administer at once carbonate of magnesia, calcined magnesia, or bicarbonate of soda, in milk or a mucilaginous fluid. Or, in case these remedies are not at hand, chalk, whiting, soap and water, etc. Tracheotomy is sometimes resorted to. Bathe external parts with soap and water, and subsequently treat like ordinary burns.

Post-Mortem Appearances.—Stains about the mouth, fingers, etc., of the acid employed. The appearance of the body may be healthy. The oral cavity is usually white and corroded at first, this turning to a dark-brown and shrivelled condition. Swelling of the epiglottis and glottis is present, and the œsophagus has appearances similar to those of the mouth.

The stomach is generally found to be in a contracted state, its outer surface being very vascular, corroded, and occasionally perforated. Sometimes it is distended with gas, and contains a thick, dark-brown fluid. The inner surface may present a charred appearance, and the mucous membrane between the rugæ be of a scarlet hue. Similar appearances are presented by the duodenum and small intestines, although to a less degree. The peritoneum may be intensely inflamed, as a result of the escape of the stomach contents (perforation) into the abdominal cavity.

POISONING BY THE ALKALIES AND THEIR SALTS.

POTASSA—SODA—AMMONIA.

Common Effects—Symptoms—Treatment—Post-Mortem Appearances—Toxicological Examination—Tests.

Common Effects.—The effects of the three alkalies are very similar, and somewhat resemble those produced by the mineral acids. They cause disorganization and complete destruction of the tissues with which they come in contact.

These substances occasionally prove fatal as the result of accident; they are rarely employed for homicidal poisoning.

Potassium hydrate—*caustic potash*—is a white, crystalline mass which deliquesces readily, absorbing water and carbonic acid; its action is strongly alkaline, and it is readily soluble in alcohol and water. It is cast in moulds, and is usually found in the market in the form of thin sticks.

Sodium hydrate—*caustic soda*—is a white, crystalline substance, usually found in the market in cylindrical sticks. It attracts moisture, and on exposure changes to sodium carbonate.

These caustics occur under the names *potash*, *pearlash*, and *soda ash*, or *soap lees*.

Ammonia,—*hartshorn*,—when pure, is a gas, colorless, of a pungent odor, and specific gravity of 0.59. The *aqua ammoniæ* of commerce is a cencentrated solution of the gas in water. The vapor of ammonia is poisonous, and may prove fatal by causing inflammation of the larynx and trachea, or even of the lungs.

Symptoms.—When administered in the concentrated condition, soda and potash have an acrid taste and excoriate the buccal cavity. The burning pain in the throat may extend to the stomach. This is followed by vomiting, first, of mucus, then of blood; there is difficulty in swallowing; and the lips, tongue, and pharynx become swollen, inflamed, and raw. Severe shock usually follows these symptoms; the skin is cold and clammy, and the pulse feeble and rapid. The patient soon becomes weak and exhausted, and may pass into a comatose condition.

Death may follow in a few hours, although the time is variable, the fatal result depending upon the degree of concentration rather than upon the quantity. If the patient recovers from the primary effects of the poison, stricture of the œsophagus and consequent inability to swallow food and drink follow; or ulcerations of the stomach or stricture of the duodenum may result. Any of these affections prevent the proper digestion of the food, and the patient finally dies from starvation.

Ammonia produces similar symptoms to the above, although it is more irritating, producing a sensation of choking, intense heat, and burning in the throat, œsophagus, and stomach. Besides the caustic effects of ammonia, there may be cerebral symptoms, producing rapid death. A characteristic feature of ammonia-poisoning is the frequency with which the air-passages are affected. An enema of the strong solution of ammonia has caused fatal results.

Ammonium carbonate (smelling salts) is an active poison, concentrated solutions of it causing severe pain, vomiting (sometimes of blood), and occasionally obstinate constipation.

Treatment.—The alkali should be neutralized, as far as possible, by administering vinegar and water, or weak organic acids, or by oranges, lemons, etc. Oils, which form soaps with these alkalies, may be of benefit. Good can also be accomplished by giving barley-water, milk, solutions of

albumen or gum, etc. The use of the stomach-pump should be avoided, as it is extremely dangerous where the œsophagus is likely to be corroded, for fear of perforation. Opium should be administered if the pain is severe.

The treatment of ammonia-poisoning is similar to the above. The effects of the inhalation of the vapor are best controlled by smelling acetic acid or dilute hydrochloric acid.

Post-Mortem Appearances.—In recent cases the mucous membrane of the mouth, throat, œsophagus, and stomach will be found softened, detached, and chocolate-colored, or even black. When the patient has succumbed to the secondary effects of the poison, signs of ulceration will be noticed in the œsophagus and stomach or intestines with more or less constriction.

The stronger ammonia produces post-mortem lesions similar to those of soda and potash. The mucous membrane of the mouth and throat is corroded and covered with false membrane. The stomach may be perforated in some instances, its lining membrane being congested and blackened.

Toxicological Examination.—Characteristics of caustic potash and soda are the soapy feel and frothy appearance. It is usually sufficient to evaporate the suspected liquid to dryness; then heat thoroughly in order to char the organic matters. Digest the ash in distilled water and filter. The alkali will be found in solution as the carbonate.

If it is necessary to separate the caustic alkali from the carbonate that may be present, the liquid is evaporated to dryness and the residue treated with absolute alcohol. This will dissolve out the free alkali, but not the carbonate, as it is insoluble. After filtering and evaporating, the process of incineration is performed. The tests to follow will then be apropos.

Ammonia.—If the organic matter is in a state of decomposition, it will be difficult to recover ammonia, on account of its volatility. Ammonia is itself generated by decomposing animal matter. If ammonia or its carbonate is present, the liquid has an alkaline odor and reaction. One-fourth of the mixture should be distilled over, and the vapors conducted through a bent tube into a cold receiver, into which a quantity of water has been placed. Other salts of ammonia are to be looked for if ammonia is not evolved by the methods just described. This is accomplished by treating the residue in the retort with strong alcohol, then filtering and heating with caustic potash. Distil as before, and test.

Tests.—*Potash:* (1) The potash compounds give a violet color to the smokeless flame of gas or spirit.

(2) The spectrum of this flame shows two bright lines,—viz., one in the red, one in the violet.

(3) Tartaric acid throws down a white precipitate of acid tartrate of potassium (cream of tartar) on standing or stirring. The addition of a little alcohol increases the delicacy of this test.

(4) Perchloride of platinum produces a yellow granular precipitate of

potassio-platino-chloride. This chemical has no effect upon soda, but it will precipitate ammonia.

Soda: (1) With the exception of the antimoniate, all the sodium compounds are soluble, and give an intense yellow color to the smokeless flame of gas or spirit.

(2) A bright line in the yellow band of the spectrum is observed.

(3) Antimoniate of potash gives a white precipitate of antimoniate of sodium, but the liquid must be freed of all bases excepting the alkalies.

Ammonia: (1) Ammonia and its compounds are recognized by their volatility and by their power of setting free ammonia gas when subjected to heat, either by themselves or with calcium hydrate (lime-water).

(2) The gas has a characteristic odor, and will turn blue a wet piece of red litmus-paper which has been exposed to its vapor. It will also give white fumes in the presence of hydrochloric acid.

(3) An alkaline reaction is characteristic of the ammonium compounds.

(4) A strong solution of ammonia in excess, when added to a copper salt, develops a deep sapphire color. A white precipitate is formed with corrosive sublimate. A yellow precipitate is formed of ammonio-platino-chloride with perchloride of iron.

Quantitative Analysis.—Potash is determined as a double chloride with platinum. (*Vide* Test.) After the precipitate is washed with alcohol, dried, and weighed, it will be found that every 100 parts of the double chloride represent 22.5 parts of caustic potash, or 28.25 parts of anhydrous carbonate.

The determination of *ammonia* is the same as that of potash. Every 100 parts of the double chloride represent 7.62 parts of pure ammonia.

POISONING BY THE ALKALINE AND EARTHY SALTS.

NITRATE OF POTASSIUM.

(Nitre. Saltpetre.)

General Remarks—Symptoms—Treatment—Post-Mortem Appearances—Toxicological Examination—Tests.

Potassium nitrate is the result of the decay of nitrogenous substances in the presence of carbonate of potassium. It crystallizes in six-sided rhombic prisms, fuses at 338° C., and at higher heat evolves oxygen. It is principally employed in the manufacture of gunpowder, but is also used in medicine. When acted upon by sulphuric acid it gives off nitrous fumes, and when administered in large doses is extremely poisonous.

Symptoms.—There is burning pain in the throat and epigastrium, and in the concentrated state it acts as a powerful irritant to the alimentary mucous membrane. There is also vomiting (hæmatemesis); bloody stools; cold, clammy skin; frequent pulse; muscular weakness; syncope and collapse, sometimes preceded by convulsions or paralysis; suppression of the urine; and death.

Sometimes the impression of the poison upon the nervous system, after large doses, is more decided than the local effects.

An ounce to an ounce and a half, in a concentrated state, may be regarded as a fatal dose, although an ounce has proved fatal in three hours.

Treatment.—The treatment consists in evacuating the contents of the stomach, and giving opiates, demulcents, and stimulants to relieve pain and depression. External applications of fomentations, etc., are of service. There is no chemical antidote.

Post-Mortem Appearances.—Marks of violent inflammation are found after death in the stomach and intestinal canal. The lining membrane may be detached in places. Perforation may follow the use of the poison. Sometimes the contents of the stomach are tinged with blood.

Toxicological Examination.—The toxicological examination is the same as that for nitric acid, which see. Nitre has been discovered in the urine, liver, spleen, and kidneys. It is chiefly eliminated by the urine, increasing the amount.

CHLORATE OF POTASSIUM.

This salt is derived from chloric acid, in which the hydrogen is replaced by potassium. It possesses a saline, cooling taste, is astringent, and is employed to make oxygen. It is used in medicine, and in doses of from half an ounce to an ounce and upward has proved fatal to adults. Potassium chlorate explodes violently when heated or rubbed up with oxidizable substances. It increases the excretion of urine, but does not affect its chemical reaction.

Symptoms.—It acts as a powerful irritant to the alimentary canal and nervous system. Death is usually preceded by salivation, great dyspnœa, cyanosis, delirium, coma, tonic and clonic spasms, and occasionally ecchymoses. The skin is generally jaundiced. Poisonous doses of this substance interfere with the oxygenation of the blood-corpuscles and produce methæmoglobin. Acute tubal nephritis supervenes, and the excretion of urine is increased, although its chemical reaction remains unchanged.

Treatment.—Similar to that pursued when dealing with the other salts.

Post-Mortem Appearances.—The blood is usually found to be of a brownish color, thickened, with a tendency to agglutination of the blood-globules.

BITARTRATE OF POTASSIUM.

(Cream of Tartar. Argol.)

This salt is very much used in medicine, and has caused death in at least one instance. Concentrated doses (two ounces) produce poisonous symptoms similar to those produced by nitrate of potassium. Paralysis of the lower extremities may occur. Death generally takes place within forty-eight hours.

SULPHATE OF ALUMINUM AND POTASSIUM.

(Alum.)

Alum is a powerful irritant in large quantities, causing vomiting and purging. It has caused death in one case at least. In small doses it is a powerful astringent.

SULPHATE OF POTASSIUM.

The action of this salt is that of an irritant when administered in large quantities. Death has been caused by ten drachms. Sulphate of potassium crystallizes in rhombic prisms. Its taste is bitter and saline, and it was formerly employed in making Dover's powder. Arsenic may be an impurity of this salt.

Ordinary purgative salts may cause great irritation and prove fatal. Overdoses of Epsom salt, and even common salt, have caused death. (Christison and Taylor.)

CHLORINATED POTASSA AND SODA.

(Bleaching Salts.)

These salts have occasionally caused death. In a case reported by Tardieu, a child was poisoned after taking divided doses of this substance, and died in a few weeks. The identity of the poison was established by the discovery of an abnormal amount of chloride of sodium in the kidneys and urine. This was supplemented by the further discovery of a formation of chloride of lead on the mouth-piece of the bottle, which was composed of lead and contained the poison. Characteristic stains of a reddish-white color were apparent on the child's cap.

SALTS OF BARIUM.

With the exception of the insoluble sulphate, all of the barium salts are active poisons. Their symptoms are very similar to those produced by nitrate of potassium. There are decided nervous symptoms and palpitation of the heart.

The post-mortem signs are of an inflammatory nature, such as congestion of the mucous membrane of the stomach and intestines, inflammation of the brain and air-passages. The heart contains dark blood.

The antidotes are the soluble sulphates (sulphate of soda or of magnesium). Evacuate the contents of the stomach by emetics and mucilaginous drinks. Subsequently use antiphlogistic medicines.

Mode of Extraction from the Stomach.—After filtering the contents of the stomach, the residue is boiled with sodium carbonate, filtered, and the result flushed with distilled water acidulated with hydrochloric acid. The filtrate may be tested for baryta, the oxide of barium, as follows: Add diluted sulphuric acid to the filtered liquid, boil the mixture, and filter again.

Destroy the organic matter on the filter-paper by burning, and boil the residue with water acidulated with sulphuric acid. Filter again and weigh. Every 100 grains indicate 65.66 of barium oxide, thus denoting the amount of soluble barium salt.

Tests.—*Chloride of barium* crystallizes in plates, which are soluble in water. With sulphuric acid, or with an alkaline sulphate, it throws down a white insoluble precipitate. The powdered salt, burnt on platinum wire in a smokeless flame, gives to this flame a greenish-yellow hue. With nitrate of silver the chloride precipitates a white silver chloride.

Carbonate of barium, which is an insoluble white powder, is completely dissolved with effervescence of carbonic anhydride upon the addition of diluted hydrochloric acid. When evaporated, it presents crystals of barium chloride.

CHAPTER VI.

ORDER II.—SPECIFIC IRRITANTS.

PHOSPHORUS.

General Remarks—Symptoms—Treatment—Post-Mortem Appearances—Toxicological Examination—Tests—Diagnosis.

Phosphorus is a wax-like, colorless, or slightly yellow, semi-transparent solid, which is luminous in the dark. Some of the physical properties of this substance are its softness and toughness at ordinary temperatures, its insolubility in water, and its solubility in ether, alcohol, and carbon disulphide, from the latter of which it crystallizes in rhombic dodecahedra. It occurs in two allotropic states; the one is yellow and the other dark red. The latter modification is called *amorphous*.[1] The dark-red variety is insoluble

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[1] The following table exhibits the difference between *Common Phosphorus* and the *Red* variety:

Common Phosphorus.	*Red Phosphorus.*
Poisonous.	Not poisonous.
Evolves a strong odor.	Almost odorless.
Luminous.	Not luminous.
Melts at 44° C.	Does not melt.
Transparent.	Opaque.
Soluble in various liquids.	Nearly insoluble.
Crystalline.	Amorphous.
Soft and waxy.	Hard and tough.
Flexible.	Brittle.
Oxidizes in the air.	Unalterable in the air.
Unites readily with other elements.	Is rarely acted on by other elements.
Nitric acid acts on it with great energy.	No effect.

(*From Percy's Prize Essay.*)

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in carbon disulphide, is not luminous, nor is it poisonous; it is prepared by heating the yellow phosphorus in an atmosphere of carbonic acid gas to 300° C.

One of the technical uses of phosphorus is in the manufacture of matches. It is also employed as an ingredient of rat-poison. In its *free* state it acts as a powerful irritant poison. It is much more frequently used for poisoning in Germany and France than in England and the United States.

The way in which it is usually employed is in the form of phosphorus paste (rat-poison), or the ends of matches. Fatal results have occurred from children sucking the ends of matches, and in one instance a child died from the effects of chewing two matches. Correspondingly small amounts have proved disastrous to adults. The quantity required to destroy life varies: one-fiftieth of a grain has caused the death of a child. Lobel, of Jena, reports the case of a lunatic who died from the effects of about one-tenth of a grain. One and five-tenths of a grain killed a man, and one-eighth of a grain a woman, within twelve hours. A case is recorded in which a child recovered after having swallowed one drachm of rat-poison, and another of a child who recovered after having sucked three hundred matches.

The period at which death takes place is also subject to variation. In one case it occurred in half an hour, one in thirteen hours, one in twenty-four hours, and others at periods varying from two to twelve days. The most common time is from the third to the seventh day.

The *local action* of phosphorus causes severe burns and sloughs, and not infrequently systemic intoxication. It ignites when handled carelessly.

Symptoms of Acute Poisoning.—Phosphorus acts insidiously, sometimes producing fatal results soon after its administration. Usually toxic effects are produced in from one to three hours after its ingestion. Violent epigastric pains occur, followed by nausea. The vomited matters smell of the poison, and are luminous in the dark. If the phosphorus passes into the intestines, violent purging takes place.

The pulse is at first strong, then feeble and rapid. Thirst is intense, and restlessness and anxiety correspondingly great. Convulsions usually precede the delirium, or coma, and death. The urine is diminished in quantity, and contains albumen and blood. Jaundice may supervene after a few days, if the patient survives. In that case the urine will contain biliary pigment. The pupils are usually dilated, the temperature low, and the abdomen distended.

Symptoms of Chronic Poisoning.—In chronic poisoning by phosphorus the patient experiences great fatigue, severe griping pains in the abdomen, diarrhœa, intermittent toothache, and more or less swelling of the cervical glands.

The teeth become carious, the gums swollen, and pus may issue from the latter. The gums retire more and more each day from the teeth and eventually the maxillæ are found to be in a state of necrosis.

There are gastric disturbance, nervous irritability, falling of the hair, eruptions upon the skin, and tubercular deposits. A black condition of the blood may exist, and the urine is loaded with phosphates.

Treatment (*Acute Poisoning*).—Sulphate of copper in five-grain doses should be administered at once as an emetic. It may act as an antidote by forming a less soluble phosphide. Magnesia (hydrated) or its carbonate should be given freely in mucilaginous fluids as a purgative. Small doses (one-twelfth of a grain every fifteen minutes) of sulphate of copper should be continued as an antidote or emetic. A better plan, however, is the administration of oil of turpentine. It must be given early, and the French, or old, common, crude oil is to be employed. This forms with phosphorus an almost insoluble mass, neutralizing the effects of the poison. The introduction of oxygenated water into the stomach through a tube and the inhalation of free oxygen have been highly recommended by Dr. Percy.[1]

For the general depression, opium is admissible to counteract its effects. Transfusion should be resorted to if the blood is much damaged. The use of *oils* (except oil of turpentine) or *fatty matters* must be avoided, since they dissolve the phosphorus and thus assist its absorption.

It is very important for those who are employed in phosphorus manufactories to observe certain precautionary measures; these are change of clothing every day after work, and extreme cleanliness, the face and hands always being washed in some slightly alkaline fluid. The mouth should always be rinsed with a weak solution of sodium carbonate. Alkaline drinks are advisable. Turpentine vapors diffused thoroughly through the rooms occupied by workmen in phosphorus factories are recommended.

Post-Mortem Appearances.—These are very peculiar, and vary according to the form of the poison taken. When the poison is administered in the pure state, or dissolved in oil, the lesions are usually situated in the œsophagus and alimentary canal. In rapidly fatal cases there are the ordinary signs of irritant poisoning, more or less distinctly marked. At a later period there may be a peculiar jaundiced (icteric) hue of the skin, and ecchymosis beneath the pleura, peritoneum, and pericardium. This may likewise exist in the lungs, kidneys, bladder, uterus, muscles, and subcutaneous tissue. This peculiarity is perhaps due to the speedy disintegration of the blood-globules. Bloody fluid may be found in the visceral cavities. The most constant change found in the *stomach* is a granular degeneration of the cells which fill the gastric follicles, occasioning a change in appearance of the mucous membrane, which is white, gray, or yellow in color, and thick and opaque. Occasionally perforation exists, but the usual lesions are small circumscribed spots of inflammation, erosion, or gangrene. The *small intestine* is either in its normal condition or congested.

Acute fatty degeneration of various viscera, such as the liver, kidneys, and heart, and of the walls of the arterioles and capillaries, is usually found.

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[1] Prize Essay, 1872.

Toxicological Examination.—The garlicky odor and the luminosity occasioned by the whitish fumes in the dark of the stomach contents are characteristic of phosphorus, and should be carefully sought for. If the mixture is ammoniacal from putrefaction, the display of luminosity is lost. This is prevented by neutralizing the ammonia with sulphuric acid. Particles of phosphorus may be obtained as a sediment by washing the contents of the stomach with water. These are placed in a tube, plunged into hot water, and melted into a mass. If this is spread out on a metallic plate and heat applied, the particles will ignite and burn brilliantly.

Phosphorus may be separated from organic matters by the action of carbon disulphide. This reagent is a ready solvent of the poison. The best method of extraction, however, is that of Mitscherlich, a process employed where the substance is either in solution or in too minute a quantity for the other tests.

Mitscherlich's Method.—The principle of this test is based upon the distillation of the substance or mixture suspected to contain phosphorus from water acidulated with sulphuric acid, when, upon coming in contact with the cool surface of the condenser, it displays a distinct luminosity. The distilled poison, with the aqueous vapor collected in the receiver, imparts the characteristic odor. This is an exceedingly delicate and accurate test; but alcohol, oil of turpentine, ether, and other essential oils interfere with its success. Dr. Reese states that one-sixtieth of a grain of phosphorus produces a luminosity for half an hour in the condensing tube. The poison thus collected by this test may be further oxidized (with nitric acid) and estimated as phosphoric acid.

Tests.—(1) It is recognizable by its smell and taste. (2) By the action of nitric acid upon it, it is converted into phosphoric acid. (3) By boiling the material supposed to contain it in acidulated water, and allowing the vapors to come into contact with a paper containing nitrate of silver, which is changed to a dark color by the formation of silver phosphide. (4) In its free state it is easily detected by its white, waxy appearance.

Diagnosis.—This will depend upon the odor exhaled by the patient, the luminosity of the breath and vomited matters, together with the other symptoms and post-mortem lesions referred to before. Chronic cases might be mistaken for yellow atrophy of the liver.

IODINE.

Iodine is a crystalline, elementary body of metallic lustre. It has a specific gravity of 4.95, fuses at 113° C. to a liquid, and, boiling at 175° C., gives off dark-violet vapors. Iodine is readily soluble in alcohol and sparingly so in water. Its chemical properties are similar to bromine and chlorine, but weaker.

In nature iodine occurs in sea-water and mineral springs; also in seaweed. Medicinally it is used as tincture, compound tincture, and ointment.

Symptoms.—*Acute Form.*—Iodine produces a local irritant effect and a remote influence. In large quantities it occasions heat and pain in the throat and abdomen, with vomiting and purging, the latter possessing the odor characteristic of the poison. The vomited matters sometimes contain blood, but as a general thing are yellowish in hue, except when mixed with farinaceous articles, when their color is blue. Giddiness and faintness, with headache and convulsive movements, are not infrequent. In the *chronic* form there are nausea, vomiting, purging, irritability of the alimentary canal, indigestion, palpitation of the heart, enlargement of the liver, and cramps, together with increase of all the secretions (salivation), general atrophy of the body, and a tendency to absorption of certain glands,—the testes in the male and the mammæ in the female.

Iodine may appear in the milk, sweat, blood, urine, and saliva after the administration of medicinal doses. It appears in the urine in forty minutes, and may not disappear for several days (four or five); it is present as hydriodic acid.

The amount necessary to kill is variable. Twenty grains have proved fatal; whereas, recovery has taken place after the ingestion of one drachm and a half. Death usually occurs within thirty hours after taking the poison.

Treatment.—Induce vomiting by the administration of emetics. Give freely of amylaceous fluids (boiled starch, gruel, etc.). For the chronic form (*iodism*), administer a chlorate of potassium gargle, and have the patient discontinue the poison.

Post-Mortem Appearances.—The liver is found enlarged and congested. The brain may be in a state of congestion. Ulcers have been observed in the stomach. The other lesions are those of an irritant poison.

Toxicological Examination.—The stomach contents should be filtered, and, if found to be too dark-colored, should be shaken with its own bulk of ether. The ethereal solution should be decanted and tested for the poison.

If the filtrate is clear and colorless, add a starch solution, when, if iodine is present, a blue color appears.

Disulphide of carbon dissolves iodine from organic mixtures, forming a pink solution. The watery liquid should be removed and the disulphide solution evaporated to dryness, when the poison will be left.

Tests.—(1) Iodine may be readily detected by the blue color which it imparts to starch. (2) By its solid form, volatility, color, and odor. (3) Iodide of potassium gives a blue color to starch.

Iodide of Potassium.—This substance crystallizes in cubes, has a specific gravity of 2.9, and dissolves in 0.7 part of water. It is used in medicine in quantities up to sixty grains. Sometimes it occasions alarming symptoms, such as abdominal pains (griping), headache, thirst, frequent pulse, an eruption upon the skin, salivation, with inflammation of the eyes and nostrils.

It is frequently found adulterated with the carbonate.

BROMINE.

This is an elementary liquid, of a dark, reddish-brown color, with a disagreeable odor, excessively pungent to the eyes and respiratory organs. Its specific gravity is 3.18 at 0° C., and it crystallizes at 7.3° C. At 63° C. it boils, evolving yellowish-brown vapors. It is soluble in alcohol, ether, chloroform, and carbon disulphide. One part of it at 15° C. dissolves in 39 parts of water.

Bromine occurs in nature in saline springs and sea-water. The corrosive action of this poison is very great. When administered internally, it becomes converted into hydrobromic acid.

Bromine has rarely been employed as a poison. In a case which proved fatal in seven hours, bromine was taken on an empty stomach to the amount of one ounce. The symptoms that followed were difficulty of respiration, intense abdominal pain, great anxiety, rapid pulse, and trembling of the hands. A catarrhal inflammation of the eyes and lungs may follow the irritating nature of the vapor.

Post-Mortem Appearances.—The interior of the stomach has been found coated with a thick black layer, and the mucous membrane intensely congested. Externally it may be injected. The viscera in the vicinity of this viscus may be of a deep-yellow color. The odor of bromine is usually detected in the stomach contents.

The peritoneal coats of the stomach and duodenum are generally injected.

Bromine should be separated from organic matters by means of disulphide of carbon, or by ether.

Chlorine or strong acids decompose the bromides. Bromine gives a deep-yellow color to starch.

CHLORINE.

Chlorine is a yellowish-green elementary gas of a powerfully irritating nature. Its specific gravity is 2.46, and it is freely soluble in water. The action of this gas upon the tissues is that of a corrosive, causing extreme laryngeal irritation, and even œdema and consequent asphyxia. It occasionally produces black eschars on the tongue and pharynx, and possibly perforation of the œsophagus and stomach.

It is easily recognized by its powerful bleaching properties, its smell, and its color.

ARSENIC.

Arsenic is by far the most important of all the poisons, and it is extensively used, both as a homicidal and suicidal agent. It is found in nature in the form of a metal, and exists as an impurity in several metallic substances, such as iron, copper, cobalt, nickel, and, with sulphur, as native *orpiment* and *realgar*. The metal itself is a steel-gray, crystalline, elementary solid, of metallic lustre, with a specific gravity of 5.7. It volatilizes at 180° C. without fusing, occasioning yellowish-brown fumes of garlicky odor, by which it is readily recognized. The metal is not often used as a poison, but

is frequently sold as *fly-powder*. In the latter state it becomes poisonous by oxidation to arsenous acid.

The technical use of this substance is in the manufacture of fireworks, shot, fly-powder (*cobalt—fly-stone*), enamel, glass (may be detected in glass, etc.), composition candles, etc. It is also employed extensively for the destruction of vermin, under the name of "Rough on Rats," and as various alloys in speculum metal, white copper, etc.; also by farmers for washing sheep, and to improve the coats of their horses; by ship-builders, to protect their timber from worms; and by the peasants in certain parts of Styria and Hungary, who are said to eat from two to five grains of arsenic daily,—the men doing so to increase their physical powers of endurance, and the women that they may improve their complexions.[1]

Arsenic, from a medico-legal aspect, as a rule, signifies *arsenous acid*, or *white oxide of arsenic.*

ARSENOUS ACID, As_2O_3.—*White Arsenic; "Rough on Rats."*—This substance occurs in commerce as a white, heavy powder, or in masses. It is almost without taste, although occasionally slightly sourish, but not acrid. It is only slightly soluble in water (1 to 2 parts in 1000); more readily so in boiling water (60 to 80 parts dissolve in 1000). Arsenous acid volatilizes at 218° C. in the form of a white vapor, which is odorless. On cool surfaces this vapor is deposited as an amorphous powder or in octahedral crystals. Although this poison is quite heavy (ʒi = grs. 150), it is possible to suspend large quantities in thick fluids, like soups, milk, gruel, coffee, etc., without possibility of its presence being suspected.

Symptoms in Acute Cases.—Weakness and faintness are generally the first symptoms manifested. These make their appearance in half an hour or an hour after the administration of the poison, and are attended

[1] Relative to the *immunity* experienced by certain persons addicted to the use of powerful poisons, the following hypothesis is certainly unique and worthy of reproduction: "When any toxic agent is taken into the system, there is developed in the body an antidote,—a counter-poison. If the dose of the drug taken be increased slowly, *pari passu* with the power of the system to elaborate a corresponding dose of the antidote, the toxic effect is prevented. If the taking of the poison becomes habitual, the production of the counter-poison becomes also habitual. If, then, the taking of the poison be suddenly stopped, the elaboration of the antidote does not necessarily cease at the same time, because its production has become a habit. Hence, what we term the withdrawal symptoms, following the disuse of a drug habit, are really symptoms of poisoning by the systemic poison, which, no longer needed to antidote the drug taken, exerts its toxic action upon the body producing it. If this hypothesis be correct, we will see, when the habitual drug is withheld, the symptoms due to the leucomaine; and the treatment of this stage will consist in endeavoring to prevent the formation of this organic alkaloid, and in antidoting its effects. Certainly the most direct antidote will be the drug habitually taken, and hence the gradual withdrawal is better, so far as relieving pain is concerned, than the sudden stoppage. But our experience has been that it is better to substitute for the habit-drug some other antagonist of the toxic leucomaine."—From monograph, "Auto-toxæmia in Drug Habits," by Professor William F. Waugh, A.M., M.D., Chicago, 1895.

by a feeling of heat and constriction of the throat. Then comes vomitir which is violent and incessant, and a very constant symptom. The m ters thrown up are occasionally streaked with blood; they may be mix with bile, or consist of a thick, glairy mucus. This latter symptom co mences within two or three days after the dose, and may continue ur death.

Dryness of the mouth and throat, together with great thirst, and pain the stomach follow. Accompanying these is diarrhœa, which, however, often absent or very late in making its appearance. With this last is usua associated tenesmus. The discharge is yellowish, of the rice-water tyr sometimes bloody, and very loose.

The urine may be entirely suppressed, or, as is generally the case, scan and of a dark-red color. After a greater or less period signs of collap appear. The pulse becomes rapid and feeble, the lips blue, the eyes sunke the face white and cadaverous, the skin cold and clammy and covered wi cold perspiration, the sufferer finally dying in convulsions or coma.

In these cases death occurs in from six to twelve hours, shock, from i flammation of the alimentary canal, being the cause.

Two and a half grains may be said to be a fatal dose, although a le amount has caused death.

These symptoms are liable to great variety. Pain and vomiting m be wanting; there may be coma; frequently there is tetanus; and there a often nervous twitchings, etc. As a usual thing the symptoms are contin ous, although there may be remissions and intermissions.

The symptoms are frequently mistaken for those of cholera and chole morbus.

Symptoms in Subacute Cases.—The above train of symptoms a less strongly marked; may make their appearance more slowly, or contin longer if the quantity of arsenic administered is smaller, or if the excess poison is eliminated rapidly by antidotes, vomiting, etc.

All of the symptoms manifested in the acute cases, particularly th due to inflammation of the digestive tract, are present. But in these ca the most constant symptoms are the vomiting and the distended and ten condition of the abdomen. In addition, signs of inflammation of the li and kidneys are present. This latter state is occasioned by the ingestion large doses of the poison, although arsenic is eliminated by these organs from two to four hours. As a result of the acute inflammatory changes the kidney, the urine is scanty, albuminous, high-colored, and contains ca and frequently blood.

The skin is hot and dry, and occasionally covered with an erupti There are inflammation of the lips and gums, which bleed readily; dry a cracked tongue; eyes yellowish in color, due to more or less jaundice. Th may be present cramps and pains in the legs and thighs. Death general follows collapse in two or three days, or later, and is preceded by prostrati coma, or delirium.

Cerebral or Narcotic Effects.—The symptoms in these cases are pallor, dizziness, a weak pulse, great feebleness, cold skin and extremities, and the patient soon passes into a heavy narcotic sleep and dies in coma. A marked feature in the cerebral or narcotic effects is the *entire absence* of signs of gastric or intestinal irritation. Sometimes consciousness remains until the last, and the sufferer passes into a state of collapse, with or without convulsions, from which he never emerges.

The period at which death takes place in these cases is usually quite short, and patients rarely survive twenty-four hours.

This class of cases is of rather rare occurrence, being due to the quick absorption of the poison. The rapid succession of the symptoms depends on whether the arsenic was given in solution, or, if dry, in large doses on an empty stomach.

Symptoms in Chronic Cases.[1]—These symptoms are due to lesions of the nerve-fibres rather than to local irritation of the alimentary canal, to lesions of the liver and kidneys, or to the effects on the nervous system.

Such cases result from the administration of the poison for some time in small but frequently repeated doses. Another set of symptoms is occasioned in those patients who are convalescing from the effects of an acute or sub-acute attack.

Exposure to the vapors of arsenical products, or the inhalation of arsenical dust, is a frequent cause of this form of poisoning. The usual symptoms are watery and inflamed eyes, great gastric distress, vomiting, diarrhœa, headache and giddiness, arsenical eczema, a jaundiced condition of the skin, great emaciation, local paralysis, falling of the hair, salivation, and even mania.

The symptoms are often misleading or obscure. In some cases disturbances of the sensory and motor nerves are observed, especially in patients recovering from the effects of the ingestion of large quantities of the poison. These disturbances may be a result of the slow elimination of the arsenic from the body, affecting it in the same way as when given for a considerable time. To illustrate: Pellew[2] mentions the case of a German clerk, thirty-nine years of age, of good history and previous health, who swallowed half an ounce of Paris green. After three-quarters of an hour had passed he vomited and complained of severe pain in the abdomen. The patient was without treatment for three days, but finally entered a hospital. In two weeks the following symptoms were observed: loss of sensation, more or less complete, in the forearms and legs; loss of power soon followed, the legs and hands being affected. This latter symptom continued prominent up to some three months and a half from the time of the ingestion of the poison. Sensation returned in about six weeks. The patient never lost power com-

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[1] The writer appeared as an expert in the recent and familiar "Dr. Meyer Chronic Arsenical and Antimonial Poisoning Case." (*Vide* Appendix.)

[2] Hamilton's System of Legal Medicine, vol. i.

pletely, although unable to walk or to use his hands or forearms. Eight months after he had taken the arsenic a macular eruption appeared all over his body, which was cured by sulphur ointment. The patient was then removed to another hospital, where, under the most careful treatment, he slowly improved, the hands recovering quicker than the feet. In about eleven months the use of the legs returned, and, after exactly one year's sickness, he was just able to get around on crutches, after being assisted out of his chair.

The lesions peculiar to these cases are probably due to a peripheral neuritis, a degeneration of the nerve-fibres, which progresses from the extremities towards the cord.

Similar lesions to those just mentioned are produced by lead-poisoning and chronic alcoholism, making it somewhat difficult to distinguish between them.

External Application of Arsenic.—The application of arsenic in solution, or dry, upon the skin or mucous membrane has been followed by poisoning. Cases are on record in which the substance has been introduced into the rectum and vagina, resulting in rapid absorption and symptoms of gastric irritation, as well as that of local origin. The rapidity of absorption depends more or less on whether the poison was applied to a raw or inflamed surface, or the application made upon the healthy and unbroken skin. Death, however, has followed the use of arsenical ointment, and even dry arsenic, upon the healthy skin and scalp.

The symptoms of this form of poisoning soon follow the local inflammation, and comprise the ordinary arsenical signs.

Dangerous and Fatal Quantities.—Symptoms of gastric trouble follow the administration of from one-third to one-half a grain of the poison in solution. Three to four grains of white arsenic are usually fatal. The smallest quantity on record [1] that killed was one-half ounce of Fowler's solution (two and a half grains of arsenic). This amount was taken by a woman, presumably for abortion, in varying doses for five days. A week afterwards she had fever, but no vomiting, purging, or pain in the stomach ; on the eighth day fainting-spells were observed ; and on the following day a fainting-fit, from which she never rallied. Her stomach and intestines were afterwards found to be inflamed.

Chronic symptoms have followed the use of small doses of arsenic, if continued for a long time. Cases are on record in which slight neuritis was occasioned by the administration of from four to five drops (one-twenty-fifth to one-twentieth of a grain of arsenic) of Fowler's solution, three times a day for one month. Six to seven drops a day have proved fatal.[2] One minim of Fowler's solution has caused gastro-enteric symptoms.

To convict a person of poisoning by arsenic on the evidence of mere traces, without other convincing corroborative signs, is generally considered

[1] Provincial Medical and Surgical Journal, 1848.

[2] Morris, Materia Medica and Therapeutics, Philadelphia.

a wrong act. However, when the poison extracted is subject to weight and isolation, so that it may be shown to the court and jurors, and the reputation of the analyst and his work are unquestionable, and proof exists that the arsenic came from the dead body, this form of evidence is very strong. It is well to recollect that even in well-marked cases of arsenical poisoning it is not uncommon for the analyst to be unable to find even minute traces of the poison. In the well-known case of Dr. Alexander, in which death was occasioned by white arsenic, and resulted sixteen days after its ingestion, although there was no question as to the cause of death, Dr. Geoghegan, the analyst, was unable to find even traces of arsenic either in the stomach contents or in the viscera.

Elimination of Arsenic.—It is generally stated that arsenic is not *cumulative* in the system; but that it is so to a certain extent cannot be denied, for symptoms of poisoning by this substance, once manifested, are liable to increase in severity for some time after the discontinuance of the drug.

The poison, after absorption, enters the portal circulation, much of it being taken up by the liver. This takes place in a few minutes or seconds, the quantity increasing for fifteen or twenty hours. Elimination from the system takes place through the urine, the bile, the skin, and probably through the large intestine. Thus the poison is gradually diminished, day by day, until it finally disappears entirely from the body.

The length of time required for this process varies; some authorities (Herapath, Taylor, Orfila, Geoghegan, and others) state that it takes place in from fifteen to twenty days. Others (*Boston Medical and Surgical Journal*, vol. cxix. p. c.) note the existence of infinitesimal traces of arsenic in the urine months and even years after its ingestion. This latter observation is to be taken *cum grano salis*.

Treatment of Arsenic-Poisoning.—Should the patient be seen soon after the poison has been taken, the stomach-pump may be used, but not at any later period. Emetics of sulphate of zinc or mustard may be employed, or hot milk and water given. After this the free use of *ferri oxidum hydratum cum magnesia*, provided by the "Pharmacopœia," to be followed by a dose of castor oil. Suffering is relieved by opium, and inflammation allayed by mucilaginous drinks and cataplasms. Threatening collapse should be averted by stimulants, hot-water bottles, flannels, etc.

Post-Mortem Appearances.—The brain, lungs, spleen, and bladder may be in a perfectly normal state. The usual characteristic lesions found in arsenical poisoning are inflammation of the gastro-intestinal tract and fatty degeneration of the heart, liver, and kidneys.

The Stomach.—This viscus may be empty or it may contain blood mixed with mucus. It may show traces of an inflammation of the mucous membrane in the interior of the organ, even in cases in which the poison was administered externally. The mucous coat may be corrugated and the organ contracted, or the entire interior may be of a light-red or brownish color, or there may be streaks of deep congestion. Thickening of the congested

patches is sometimes noticed; these patches may be covered with false membrane mixed with particles of the poison. Frequently there is an extravasation of blood into the mucosa and submucosa. Small petechiæ may be found upon the mucous membrane. Evidences of acute gastritis are usually present, even when the poisonous substance was absorbed by the skin or otherwise.

Often particles of solid arsenic adhere to the walls of the organ in thick, pasty, whitish-gray, or green (Paris green) patches. These spots are generally surrounded by brightly injected membrane.

The Intestines.—Inflammation is observed here similar to that of the stomach, although to a less degree. The whole of the intestines may be congested and inflamed. The large intestine is usually normal, unless the sufferer has lived for some days after the ingestion of the poison. Peyer's patches, the solitary lymph-nodules, and the mesenteric nodes are in some cases swollen.

The Heart.—When the death of the patient has been sudden, the post-mortem appearances of this organ are usually normal. Otherwise, evidences of fatty degeneration exist. The walls of the heart are pale and yellowish and less firm than in the normal state. The muscular tissue under the endocardium is ecchymotic. This ecchymosis may be observed also in the interior of the organ, but its usual site is on the left ventricle, on the posterior wall, or on the intra-ventricular septum.

The Liver.—This organ generally presents no special appearances; although, on the other hand, in some instances the symptoms of fatty degeneration are more decided than in any other organ. This is probably occasioned by the effects of the poison left behind, notwithstanding its efforts toward the rapid excretion of the drug. The organ may be enlarged, a condition usually following sudden death.

The Kidneys.—The excretion of the poison occasions a rapid inflammation, which soon causes the tissues, especially the parenchyma, to change. The kidneys are enlarged, soft, and pale. A thickened cortex and a yellowish-gray color, either in streaks or all over, are revealed by the microscope upon section of the organ.

It must not be forgotten that fatal results in subacute cases are occasioned just as much by inflammation of the kidneys and liver as by the toxic effects produced in the stomach.

The Tongue, Pharynx, and Œsophagus.—These structures may be more or less inflamed, particularly if the poison has been administered in the dry form. The œsophagus may be found streaked in patches of a dull or even bright red. It has been found corroded.

Toxicological Examination.—Observe if any arsenic in the solid state is present in the stomach and in the vomited matters. The suspected material should be diluted with water, placed in a conical glass, and allowed to settle. The liquid and lighter material are then decanted, and any heavy sediment examined carefully under the microscope for undissolved arsenic.

The rest of the material should be filtered. The solid matter is then

boiled with hydrochloric acid until disintegrated, and mixed with the filtrate. The mixture is then strained and concentrated, if necessary, by evaporation, and a portion subjected to *Reinsch's test*. If the poison is present, it may be estimated quantitatively.

The Stomach and Contents.—The stomach should be cut up into small fragments with perfectly clean scissors, and, together with its contents, placed in a clean porcelain dish. For the purpose of disintegrating the solid portions of the drug, distilled water and hydrochloric acid, known to be free from arsenic, are added to the mixture, and the whole boiled for an hour or so. The mixture is then allowed to cool. It should be placed in a strainer (muslin), and the solid matters flushed with warm water and squeezed. The filtrate is concentrated by evaporation and filtered through paper.

A portion of the liquid may now be subjected to the above-mentioned test, and if no arsenic is found, another portion may be tested with sulphuretted hydrogen. If there is still no result, it is safe to conclude that these negative results are conclusive evidence of the absence of arsenic.

If arsenic is detected, then a given portion of the liquid should be completely exhausted by Reinsch's process, and the remainder subjected to sulphuretted hydrogen, for the purpose of throwing down all the poison (arsenic). This precipitate will be of a dirty-yellowish color, and be composed of organic matter and reduced sulphur. To prove the character of this suspected sulphide, the precipitate should be thoroughly flushed on a filter. It should then be digested with pure aqua ammoniæ to dissolve out the sulphide of arsenic and organic matter, and then filtered and evaporated to dryness. If the results are satisfactory, and much arsenic be present, it will have a yellow color. If, however, the residue demonstrates the existence of but a minute amount of the poison, it must be subjected to a still further process,—one of purification. The dried residue, which is of a brownish hue, is placed in a porcelain capsule, to which a trifling amount of concentrated nitric acid is added. It is then evaporated to dryness, the acid being added until the mixture assumes a yellowish color. A few drops of caustic soda with a little pure nitrate and carbonate of sodium, are added and well stirred, and cautiously evaporated to dryness over a water-bath. With increased heat the mass becomes colorless, showing that the organic matter is entirely dissipated. The residue consists of sodium arsenate, with nitrate and nitrite of sodium. This mass is now dissolved in warm water, filtered, acidulated with sulphuric acid, and evaporated until dense white fumes appear. This reduces the mixture to arsenate and sulphate of sodium. *Marsh's* apparatus may be used in testing a portion of this solution, the remaining portion being subjected to the sulphuretted hydrogen test for quantitative analysis, the arsenic acid being first reduced to arsenous acid.

Separation of Arsenic from the Tissues.—In all cases of poisoning, the substance detected in the stomach and intestines should be separated from that absorbed in the tissues. This is important, because the poison found in the stomach took no part in the actual killing of the patient, it being merely

that which was left over. The *real* effects are occasioned by the *absorbed* poison, or that found in the liver, kidneys, spleen, and heart; for it is in these organs that the drug is found, even long after its elimination from the tissues of the stomach and intestines. Its discovery in any of these organs would be proof *positive* that the poisonous material was administered during the life of the individual. (*Vide* Post-Mortem Imbibition.)

Arsenic has been found to exist in the brain, and many analyses have demonstrated its presence, after death, in the bones and muscles. Johnson and Crittenden[1] detected 2.38 grains of arsenous acid in the organs of the body of a Mrs. Riddle. During the trial the counsel for the defence claimed that this amount was not necessarily fatal. Further analyses were carried on, tissue being taken from the arm, thigh, hands and feet, off a thigh-bone, and from a transverse section of the body itself,—in all, some twenty pounds of material. From this examination 2.85 grains were abstracted, showing a grand total of over five grains.

Dr. Pouchet, by careful experimentation, has demonstrated the existence of arsenic not only in the skin, nails, and hair of poisoned persons, but likewise in the spongy tissues of the bones weeks after its elimination from the liver, other viscera, and tissues of the body.

The various methods advocated for the preparation of the tissues for analysis depend upon the destruction of the organic matters. The *Fresenius* method is generally employed for the separation of the inorganic substance from organic matter, which is oxidized with hydrochloric acid and potassium chlorate.

Tests.—(I.) *Solid Arsenic.*—1. Arsenic is but slightly soluble in water, and when boiled or stirred in it, appears as a white film on the surface, or at the bottom of the liquid in the form of little dry masses. It is readily dissolved upon the addition of a little alkali, without changing color. When heated, it is soluble in both nitric and hydrochloric acids. 2. The particles to be tested are placed in a small reduction-tube and heated, when arsenic will be sublimed as octahedral crystals in the cooler portion of the tube. The reduction of arsenous acid is accomplished by covering the particles with a mixture (flux) of dry sodium carbonate and potassium cyanide; or with charcoal an arsenical mirror will form in the cooler portion of the tube. This latter is proved by heating the mirror, with access of air, when it will sublime in the cooler portion of the tube as a white ring, which, when examined by the lens or microscope by reflected light, will be found to be composed of the triangular facets of the octahedral crystals of arsenous acid (*sublimation test*). 3. The *reduction test* is as follows: the mixture of arsenous acid and charcoal (or potassium ferrocyanide) is placed in a small reduction-tube, which must be perfectly clean and dry, drawn to a point at its closed end, and the charcoal heated till it glows, when any white arsenic in the powder will, on heating, be reduced to metallic arsenic. This reduced

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[1] Amer. Chem. Journ, vol. ii. No. v.

metallic arsenic will evolve a garlicky odor, and deposit farther up the tube in a black or brownish ring.

The "white-cloud" deposit in the *sublimation test* may be distinguished from similar white rings occasioned by oxalic acid, corrosive sublimate, ammonium salts, calomel, etc., by its shape, or by dissolving it in hot nitric acid and applying the subjoined tests. Gently evaporate the solution to dryness, and touch the residue with strong argentic nitrate, when a brick-red deposit of silver arsenate is formed.

The "black or brownish ring" in the *reduction test* is simulated by similarly colored rings formed by the cadmium salts and mercury. The differences are these: it is not globular under the microscope; it is readily dissolved in hot nitric acid[1] and in a hot strong solution of bleaching powder; and it will form white octahedral crystals when heated after the closed end of the tube is broken off.

(II.) *Arsenic in Pure Solutions.*—As it is important, in testing for arsenic, to confirm in as many ways as possible the various processes, so as thoroughly to identify the poison, the following tests are added, to be prepared only when their use is desired. (1) The *ammonio-cupric sulphate test* is made by carefully adding aqua ammoniæ to a dilute solution of cupric sulphate, until the bluish-white cupric hydrate is barely redissolved. The clear liquid is filtered off and used. This test is spoiled by an excess of ammonia, which will dissolve the precipitate. When this reagent is added to a solution of arsenous acid, a light-green arsenite of copper (Scheele's green) is precipitated. This precipitate is soluble in ammonia and acids, but not in potassium or sodium hydrates. If the arsenic is in minute quantities, the mixture must be allowed to stand for some time, when the characteristic blue color will be deposited. (2) The *ammonio-silver nitrate test* is made by adding aqua ammoniæ to a strong solution of nitrate of silver, until the brown precipitate (oxide) is almost entirely redissolved. When added to an aqueous solution of arsenous acid, a light-yellow precipitate of argentic arsenite occurs (King's yellow). This is freely soluble in ammonia, and in citric, acetic, and nitric acids, the solutions being colorless. It is insoluble in potassium and sodium hydrates, but hydrochloric acid changes it to white argentic chloride. This test responds to one-ten-thousandth of a grain of arsenic.

Both of these tests are inadmissible in the presence of organic matter, and the first one is interfered with by the presence of hydrochloric acid.

(III.) *Arsenic in Complex Solutions.—Sulphuretted Hydrogen Test.*—The suspected solution is warmed, acidulated with a few drops of hydrochloric acid, and treated with sulphuretted hydrogen by allowing it to pass for some hours through the solution. If arsenic is present, a lemon-yellow precipitate of arsenous sulphide will result. This precipitate is insoluble in cold hydrochloric acid. It is oxidized by hot nitric acid, dissolving and forming arsenic acid. It dissolves readily in the caustic and carbonated alka-

[1] This solution will respond to the argentic nitrate test, as above.

lies and in the sulphides of the alkaline earths. According to Wormley, this test reacts with one-five-thousandth of a grain of arsenous acid dissolved in ten grains of water that has been acidulated.

This precipitate can be further tested by filtering, drying by reducing it with flux, and producing the arsenical mirror and the characteristic white ring of octahedral crystals.

Reinsch's Test.—This test consists in reducing arsenical compounds with metallic copper. For that purpose the suspected liquid is acidulated with about one-sixth of its bulk of pure hydrochloric acid. The mixture is then brought to the boiling-point, when a piece of copper gauze is introduced and the boiling continued. If arsenic is present, the copper will be coated with elementary arsenic, and will finally assume a dark steel-gray or black color.

This is used as the trial test, and may be practised in organic fluids. The sensitiveness of this test shows one-ten-thousandth of a grain; but Wormley, by the use of very fine tubes and minute strips of foil, obtained the crystals from one-fifty-thousandth of a grain. Any substance which will cause the copper to dissolve will interfere with the success of the test. Such substances are nitric acid, potassium chlorate, manganese dioxide, etc.

Besides the delicacy of the Reinsch test, it can be made quantitatively by gradually inserting into the boiling acid mixture previously weighed particles of copper until they are no longer coated. The increase of weight gives the amount of arsenic in the quantity of liquid employed.

Antimony, mercury, etc., may also deposit on the copper in this test, but they give respectively amorphous or metallic globular sublimates.

Marsh's Test.—This process depends upon generating hydrogen from pure zinc with pure sulphuric acid from a suitable apparatus. The purity of the apparatus and materials should be tested by allowing the hydrogen to burn for some time, when a piece of cold porcelain is introduced into the flame. If no stain is thus produced, introduce the suspected solution through the funnel-tube, when, if arsenic is present, arseniuretted hydrogen is evolved immediately, and the color of the hydrogen flame becomes a bluish white with some white fumes of arsenous oxide. This gas is then tested as before—that is, by placing a cold porcelain surface close over the flame, whe the arsenic present will be deposited as a black or brown stain. Accord ing to Wormley, the amount of arsenic in a good stain may not be over one eighty-thousandth of a grain.

The advantages of this test are that other compounds are readily de tected, such as arsenites, arsenic acid, arsenates, and arsenous acid. On great disadvantage, however, is that it cannot be used in the presence of or ganic matter, and another that it shows antimony as well as arsenic. Th stains of arsenic and antimony are differentiated as follows: the arseni stain is immediately soluble in sodium hydrochlorite, while the antimony i not; the process of dissolving arsenic stains in ammonium sulphite is slow antimony dissolving instantly; nitric acid dissolves the arsenic stain, an

when evaporated produces a brick-red stain with nitrate of silver, while antimony does not; the mirror in the tube, if it is arsenic, is located beyond the flame; if antimony, it is nearer and on either side of the flame.

The sensitiveness of Marsh's test shows one-fifty-thousandth of a grain.

Other important preparations of arsenic, from a medico-legal point of view, are the following: potassium arsenite, arsenic acid, cupric arsenite, cupric aceto-arsenite, the sulphides, etc.

Potassium Arsenite.—*Fowler's Solution.*—This preparation, which contains four grains of arsenous acid to the ounce, is prepared by boiling arsenous acid with carbonate of potassium and tincture of lavender. It is much used in medicine.

Arsenic Acid.—This powerful poison is prepared by the oxidation of arsenous oxide with nitric acid. The arsenic oxide absorbs water even from the atmosphere, thus forming the true acid (H_3AsO_4).

The tests for this substance are similar to those for arsenous acid. With sulphuretted hydrogen it gives a yellow precipitate; with nitrate of silver it yields a brownish-red precipitate.

Cupric Arsenite.—*Scheele's Green.*—A bright-green powder precipitated by treating copper solutions with potassium or sodium arsenite. Scheele's green contains one part of arsenous acid to two of oxide of copper. It yields crystals of arsenous acid by sublimation in a reduction-tube, and is soluble in ammonia and in nitric acid.

Cupric Aceto-Arsenite.—*Schweinfurt, Brunswick Green, Paris Green, Vienna or Emerald Green.*—This compound, which is an insoluble green crystalline powder, representing a mixture of acetate and arsenite of copper, is extremely poisonous. Paris green is used extensively for destroying potato-bugs, etc. It has been frequently employed as a means of suicide, and has also been administered with homicidal intent. The symptoms occasioned by its ingestion are in every way similar to those by arsenous acid, but it is more difficult to wash it out of the stomach.

This poison is rarely employed nowadays as a pigment for wall-paper, although it is often used to color candy, toys, etc.

Paper or other articles to be tested should be dipped in a weak solution of ammonia, when they will be bleached and the solution changed to a blue color. Add to the latter a crystal of nitrate of silver, and a film of yellow (silver arsenite) is formed around it. If a drop of aqua ammoniæ is applied to paper containing this pigment, it turns blue at once.

The inhalation of the fine powder that becomes detached from wall-papers frequently gives rise to symptoms of chronic arsenical poisoning.

Sulphides.—Of the native sulphides, the red contains seventy per cent. of the metal, and the yellow or arsenous sulphide seventy-one per cent. Orpiment is sometimes administered as a poison. Both compounds are soluble in ammonia; their toxic effects are the same as those of arsenous acid.

Arseniuretted Hydrogen.—*Arsine.*—This gas is produced by the action of nascent hydrogen upon solutions of arsenic. It is occasionally produced in the arts, but is chiefly formed in the preparation of Marsh's test.

It is a colorless, inflammable gas, having the characteristic garlicky odor. When heated, it burns to water and arsenous oxide, depositing metallic arsenic, and throwing down metallic silver when transmitted through nitrate of silver, the arsenic dissolving in the nitric acid set free.

This gas produces marked poisonous effects, having a specific action on the blood and kidneys. In other respects its action is similar to that of arsenous acid.[1]

CHAPTER VII.

ANTIMONY.

Preparation and Properties—Tartar Emetic: Symptoms—Treatment—Post-Mortem Appearances—Elimination of the Poison—Toxicological Examination—Tests—Other Preparations.

Antimony is an elementary, crystalline, bluish-white solid, of metallic lustre, with a specific gravity of 6.7. It fuses at 430° C., and is without taste or smell. The metallic character is exhibited to a greater degree than in arsenic, and it volatilizes at a bright-red heat, burning in the atmosphere to antimony trioxide. It exists in nature as black sulphide (*black antimony*, or *crude antimony*), and is employed in the arts as an alloy, mostly in type-metal.

The only preparations of medico-legal importance are *tartar emetic* and *antimonious chloride*. Antimoniuretted hydrogen has produced fatal results in animals.

TARTAR EMETIC. ($K(SbO)C_4H_4O_6$.)

This compound is also known as tartarized antimony, tartrate of antimony and potassium, and stibiated tartar, and is formed by boiling antimonious oxide with cream of tartar. It is the most common of the antimonial compounds used in medicine, and is sold as a white, crystalline powder, which is readily soluble in water with acid reaction, and in proof spirits and wine according to the quantity of water they contain. From its solutions it crystallizes in the rhombic form. When heated to redness, tartar emetic chars, from the decomposition of the organic acid, and is reduced to a mixture of carbon and metallic antimony. The taste is nauseous, styptic, and metallic.

Symptoms.—In acute poisoning by this substance there is a harsh,

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[1] *Vide* also Embalming, for possibility of distinguishing ante-mortem from post-mortem arsenic, etc.

metallic taste in the mouth after swallowing, soon followed by nausea, violent vomiting, pain in the epigastrium, intense thirst as with arsenic, cardiac depression, and profuse purging of a watery character. Sometimes blood, mucus, and bile are perceived in the discharges from both the stomach and bowels. The pulse is rapid and feeble, and there is extreme prostration, with a tendency to syncope. There are generally constriction in the throat and pain in the œsophagus. Cramps of the extremities may give rise to difficulty in diagnosing between this condition and cholera. Death may occur from exhaustion, in a stupor, in convulsions, or even in delirium.

In exceptional cases the vomiting and purging are slight, or even absent, the symptoms being those of intense prostration, with cold, clammy skin and feeble respiration and circulation, the death of the patient being due to the action of the poison on the centres in the medulla.

In *chronic* poisoning from the use of tartar emetic, the symptoms are distressing nausea, with occasional vomiting, diarrhœa, emaciation, loss of appetite, feeble heart-action, difficult respiration, slimy tongue, and increase of the secretions, such as the perspiration and urine. The countenance is pale and anxious. The patient finally dies from exhaustion.

The *external* application of the poison to the skin causes a deep pustulation. Tartar emetic is easily absorbed, and particularly from abraded surfaces. The symptoms are the same as if the poison were swallowed. After death it has been discovered in the stomach, liver, and other organs.

Minute quantities of the poison have caused alarming symptoms. Half a grain has occasioned serious results, and death has been caused in a child by three-fourths of a grain in one hour. The effects of the poison depend a good deal on the idiosyncrasy of the individual. Two or three grains have killed, while in other cases an ounce of the poison failed to destroy life.

Probably ten to twenty grains (Taylor) would be dangerous for adults if administered at once, and less than that if taken in divided doses.

Treatment.—Wash out the stomach immediately, and give tannic acid as a chemical antidote, and stimulants and opium to overcome the resulting depression. Strong coffee is of service, given after the removal of the poison from the stomach.

Post-Mortem Appearances.—These usually indicate more or less inflammation of the mucous membrane of the stomach and intestines, sometimes extending to the œsophagus and throat. The stomach and intestines are generally coated with mucus, and evidences of inflammation of these organs may be absent. The blood is unusually thin. The viscera may be engorged with blood. There may be effusions into the pleura, and the lungs are apt to show signs of emphysema. In cases in which death has followed small and repeated doses of the poison, careful examination of the cæcum and large intestines should be made. The brain is usually congested.

Elimination of the Poison.—Tartar emetic is largely evacuated by vomiting and purging, more so than is the case with other poisons. The poison absorbed into the system is eliminated by the mucous membranes,

especially of the stomach ; by the liver, kidneys, and skin. In chronic cases it is of common occurrence to find inflammation of both liver and kidneys.

Toxicological Examination.—When examining food, medicines, vomited matter, the contents of the stomach and intestines, etc., it is possible to obtain antimony by acidulating the material with tartaric acid. Gently heat, with sufficient water, over a water-bath for half an hour ; then strain and filter, and treat the solution with sulphuretted hydrogen ; allow it to stand for some hours, when the precipitate should be filtered off. This precipitate contains the antimony as sulphide, along with sulphur and the sulphides of other metals. It is next boiled in strong sulphuric acid until the sulphur fumes disappear, and filtered if necessary. This solution may now be tested by the zinc or Reinsch's test. If the amount of poison found in the stomach exceeds the ordinary medicinal dose, there is a strong presumption of poisoning ; but if the quantity is small, it is difficult to tell whether it has been administered with criminal intent or not.

It is rare for the analyst to find large amounts of the poison in the body, as it is largely expelled during vomiting and purging.

Marsh's test should be employed if the above method fails. (*Vide* Arsenic.) In examining the tissues for absorbed antimony, the Fresenius method should be employed in order to destroy the organic matter. Antimony is then separated, as above mentioned, by sulphuretted hydrogen.

Tartar emetic may be detected in concentrated urine, as in other liquids, by either the Reinsch or Marsh test ; also by dipping pure tin-foil in the acidulated solution, when a coating of antimony, if present, will form.

Antimony may be determined *quantitatively* by weighing the antimony sulphide detected by the sulphuretted hydrogen test, when 100 parts will be found to equal 194.4 of antimony. The antimony sulphide may also be dissolved in hydrochloric acid and then recovered as antimony by the Reinsch test, the increased weight of the copper slips giving the amount o poison present.

Tests.—The compounds of antimony are tested as follows : (1) Whe brought in contact with a drop of ammonium sulphide or a solution of su phuretted hydrogen, an orange-red color is the result. (2) The chloride o antimony, when put in water, produces a white precipitate. (3) Antim niuretted hydrogen burns and deposits two rings on cold white porcelai held in the flame. These rings are soluble in sulphide of ammonium, bu not in a solution of chlorinated lime. (4) Infusion of cinchona and an solution of tannin causes a dirty-brown precipitate with the salts of ant mony.

Antimony Chloride.—*Butter of Antimony.*—This compound is use in the liquor antimonii chloridi as an escharotic. It is a yellow semi-soli mass, not unlike butter, at ordinary temperatures. It is occasionally m with in cases of poisoning. Its symptoms are those of an irritant and som times corrosive poison. In treating such cases, administer magnesia in mil etc. Infusions of tannin are to be employed. Give stimulants for the collaps

MERCURY.

Mercury is at ordinary temperatures a bright metallic liquid, with a specific gravity of 13.6. It freezes at $-39.9°$ C. and boils at $360°$ C., and forms alloys with most metals. It is generally extracted from its free state by the processes of reduction and subliming the red sulphide, cinnabar.

In its metallic state mercury may be said to be non-poisonous, large quantities having been taken without disadvantage. Corrosive sublimate is the most important of the compounds, although all of the preparations possess poisonous properties to a greater or less degree.

CORROSIVE SUBLIMATE.—*Mercuric Chloride, Corrosive Chloride of Mercury.*—This compound occurs in heavy rectangular octahedra, crystallizing from water in fine rhombic prisms. It has a powerful styptic, metallic, nauseous taste, and is soluble in 15 parts of water at ordinary temperatures; its specific gravity is 5.4, it fuses at $288°$ C., and boils at $300°$ C. Alcohol dissolves about thirty per cent. at ordinary temperatures; ether, thirty-five per cent.

Symptoms.—These usually come on at once after the ingestion of the drug. It acts as a corrosive, and causes great pain in the throat, bloody stools, slow pulse, bloody and mucous vomit, great thirst, suppression of the urine, and collapse. The pulse soon becomes quick, feeble, and irregular, and salivation is apt to appear on the second or third day, although it may be absent.

The *external* application of the poison may give rise to similar symptoms and post-mortem lesions as when taken internally.

The minimum fatal dose is about three grains, but recovery has taken place after eighty grains. It may prove fatal in from half an hour to two weeks.

In *chronic* cases there are loss of appetite, metallic taste in the mouth, soreness of the gums, fetid breath, increase of the salivary secretion, pain in the stomach and abdomen, diarrhœa, rapid pulse, hot skin, etc. There are emaciation and general weakness, and at the margin of the gums a bluish line, as in lead-poisoning.

Treatment.—Administer at once white of eggs or wheat flour mixed with milk. Encourage vomiting by emetics, and for the troublesome salivation gargles of potassium chlorate and alum should be employed. The subsequent treatment must depend upon the symptoms.

Post-Mortem Appearances.—These are confined chiefly to the digestive canal. The mucous membrane of the mouth, fauces, and œsophagus is softened and of a whitish or bluish-gray color. The stomach is often softened, particularly at the cardiac extremity. These appearances may also be shown by the intestines, especially the cæcum. There may be inflammation of the kidneys and bladder. The congestion of the former is especially marked about the Malpighian bodies, the epithelial cells being deformed, granular, and partially destroyed. The bladder is contracted and empty.

Dr. Byasson[1] states that corrosive sublimate takes two hours to reach the urine, four hours to reach the saliva, and that it is eliminated from the system twenty-four hours after its ingestion.

Toxicological Examination.—Solid particles of the poison may be found in the stomach; these should be collected and identified. The method to pursue in preparing the stomach and its contents, etc., has already been described. After the mixture has been acidulated with hydrochloric acid and gently warmed it is filtered, and the filtrate subjected to the sulphuretted hydrogen and Reinsch tests. This process indicates the presence of mercury, but not of the corrosive sublimate. To detect this salt the stomach contents should be concentrated by evaporation. This is shaken with a large bulk of ether, which readily dissolves the poison; the ether is then decanted and distilled at a gentle heat. The residue is tested for the salt.

The saliva may be tested for mercury by acidulating about two drachms of it with hydrochloric acid and placing in it a piece of bright copper, watching if it becomes coated with silver. When the copper is subjected to heat in a reduction-tube, metallic mercury is obtained.

The urine may be examined by taking fourteen ounces of the fluid and concentrating it by evaporation to one ounce. To this is added hydrochloric acid, when the whole mixture is filtered. The filtrate is then boiled, together with a piece of bright copper, and placed in the reduction-tube.

Tests.—*Mercury Compounds.*—(1) The application of heat sublimes and decomposes the mercurial salts. (2) Metallic mercury is obtained by charcoal and sodium carbonate (reduction test). (3) Metallic mercury coats copper strips when the latter are placed in an acidulated solution. (4) The metal (black) is thrown down by stannous chloride in excess. (5) Gold or copper moistened with a mercury solution and touched with a pointed piece of steel is coated with a silvery stain.

Mercurial Salts.—(1) A black precipitate ("black wash") is caused by liquor calcis and the alkalies. (2) An olive-green precipitate is produced by the iodide of potassium. (3) A bright-red precipitate is thrown down by potassium chromate. (4) Sulphuretted hydrogen gives a black precipitate.

Mercuric Salts.—(1) Liquor calcis and all of the alkalies, with the exception of ammonia, produce a yellowish precipitate ("yellow wash") (2) Liquor ammoniæ, with corrosive sublimate, yields a white precipitate (3) The scarlet iodide of mercury is given by the iodide of potassium. (4 Sulphuretted hydrogen in excess produces a black precipitate, which turn to red when sublimed.

Other preparations of mercury have been used as poisons. Among these may be mentioned calomel (subchloride of mercury), hydrargyrum ammoniatum (white precipitate), peroxide of mercury (red precipitate), the oxysulphate (turpeth mineral), etc.

[1] Woodman and Tidy, Medical Jurisprudence.

LEAD.

Lead in its metallic state is not considered poisonous, but when converted into carbonate or other poisonous compounds (acetate, subacetate, etc.) it becomes so.

The metal itself is a bluish-white, heavy substance, soft and ductile, of a bright lustre when freshly cut, and with a specific gravity of 11.37. It fuses at 325° C., and forms alloys with other metallic substances. The principal source of lead is galena, a native lead sulphide, from which it is separated by roasting.

Cases of acute poisoning by lead are rare, but may occur from taking considerable quantities of the soluble salts. Chronic or slow poisoning is occasioned by absorption of the metal in small amounts, day by day, for considerable periods. This form of poisoning is of frequent occurrence among those employed as plumbers, painters, type-founders, miners, etc. Other sources of poisoning are found in drinking-water or beer conducted through new leaden pipes, cosmetics, hair-dyes containing lead, etc.

Pure water does not act on the metal, but by the alternate action of air and water it becomes coated with lead hydrate, which is but sparingly soluble in water. In this manner new lead pipes may occasion contamination and cause poisoning. If the water contains carbonic acid gas and salts, the metal becomes coated with insoluble carbonate and sulphate, and old pipes, therefore, give greater immunity from contamination. An excess of carbonic acid, however, may cause the carbonate to become slightly soluble. Lead-contamination may result from the presence of nitrates and nitrites in water conducted through lead pipes.

Symptoms of Acute Poisoning.—Dryness of the throat, a metallic taste, and thirst are soon experienced after swallowing the poison. The pain experienced is colicky and intermittent, and is chiefly referred to the umbilicus, pressure on which affords decided relief. Rigidity of the abdominal muscles is generally present. The pulse is slow and weak. The face assumes an anxious expression, and there is extreme prostration. Constipation is a constant symptom, occasioned, no doubt, by paralysis of the muscular coat of the intestines. The urine is usually scanty and very red in color. As the case progresses the patient is seized with severe cramps, paralysis of the lower limbs, and often spasms of a tetanic nature and convulsions. The skin is bathed in cold perspiration. The mind is generally clear to the last. Vomiting is not a constant symptom.

The *time of death* in fatal cases is usually three or four days after prostration.

Symptoms of Chronic Poisoning.—Chronic lead-poisoning may be brought about in three ways: (1) Where the poison has been taken inwardly, as in drinking-water. (2) Where it has been applied to the skin externally, as in the use of hair-dyes. (3) Where it has been taken

into the system through the lungs by inhalation, as with artists, painters, etc.

The time required for the exhibition of the symptoms varies with the amount of lead that reaches the system. Thus, the symptoms may appear in a few weeks, or even days, or they may not be observed until the exposure has lasted for years. Lead is a poison that accumulates very slowly in the body until the poisonous limit is reached. Sometimes a local manifestation of the effects of the poison is apparent, such as the paralysis experienced by plumbers, etc.

The patient at first feels run down and wretched. There are indigestion, obstinate constipation, loss of appetite, intensely fetid breath, excessive thirst, and a constant metallic taste in the mouth. The expression of the countenance is dull and anxious. There may be fever, but its presence is unusual. The pulse is normal. Intestinal colic is of frequent occurrence, and the navel is retracted. Should there be a movement of the bowels, it is accompanied by great pain, and the stools are of a black color, due to the formation of lead sulphide. The urine is generally scanty and micturition painful. In the female vaginismus is often observed.

The *blue line* on the gums, usually near the margin of the teeth, occurs early in lead-poisoning, and is rarely absent. It is due to the action of sulphuretted hydrogen, derived from the fluids of the mouth, upon the lead circulating through the capillary blood-vessels.

Lead-paralysis occurs in the larger number of cases, and may even arise from a single attack of chronic poisoning. It has occurred in the absence of any attack whatever. The limbs most frequently attacked with paralysis are the upper, especially the extensor muscles. The loss of power and wasting of the arm are first seen in the extensor muscles of the forearm (drop-wrist). The corresponding leg muscles may also be affected, but always after the attack on the upper extremities. Death usually occurs from general anæmia and malnutrition, the kidneys being especially affected.

Excretion of Lead.—But extremely small quantities of lead are present after death. The poison has been found in the liver and kidneys, also in the urine. Excretion is favored by the administration of potassium iodide which probably dissolves the lead. It may be eliminated also by the bile, skin, and intestines. The process of excretion is very slow.

Treatment.—In *acute* poisoning by lead the stomach contents should be evacuated and dilute sulphuric acid or Glauber's or Epsom salt given, together with the sulphates of sodium and magnesium.

In the *chronic* form the source should be located and removed. For example, in the case of painters the utmost cleanliness should be observed, and diluted sulphuric acid administered as a drink. Purgatives should also be given to overcome the constipation, and the soluble sulphates, with baths of potassium sulphide, as antidotes. Aid the elimination of the poison by large quantities of diluents and iodide of potassium. Atropine is of service in lead-colic, and electricity and strychnine in lead-palsies.

Post-Mortem Appearances.—These are not very distinct. There may be an inflammation of the intestinal tract, also contraction. The stomach may present a whitened appearance. In chronic cases the large intestines may appear contracted, and the specially affected muscles flabby and whitish.

Toxicological Examination.—The organic substances should be concentrated to dryness and incinerated. Dissolve the residue in nitric acid, and evaporate the solution to dryness over a water-bath ; dissolve in water, and apply the sulphuretted hydrogen test. If the sulphide is sufficient, it is then reduced by the blow-pipe to a malleable particle of lead ; or it may be dissolved in nitric acid, the acid evaporated, and the residue dissolved in water, to be tested with potassium iodide, when the lead iodide, after heating, will be observed under the microscope as six-sided plates. The examination of the urine, which should never be neglected, is performed as just described.

Lead may be detected in sweetmeats, etc., colored with this metal, by slightly moistening them with water and putting them on a plate in the centre of which a small capsule filled with a drachm of sulphide of ammonium is placed. The whole is then covered with a tumbler, when, if lead be present, the evolved sulphuretted hydrogen will blacken the sweetmeats.

Tests.—(1) Lead compounds give from acid solutions a black precipitate with sulphuretted hydrogen. (2) The same precipitate with ammonium sulphydrate, insoluble in excess. (3) A white precipitate is produced with sulphuric acid or any soluble sulphates. (4) With potassium iodide a yellow precipitate ; also with potassium chromate.

Acetate of Lead.—*Sugar of Lead.*—This substance is used in medicine as a sedative and astringent. It is an ingredient of different hair-dyes, and may prove poisonous if its use is persistently continued.

Sugar of lead crystallizes in large, colorless prisms, and is of sweetish taste, acetous odor, acid reaction, and efflorescent on exposure. With water containing carbonic acid it causes turbid solutions, on account of the precipitation of lead carbonate.

Lead Chromate.—*Chrome Yellow.*—This salt is employed as a pigment. It is also used to color yellow confections and buns. Lead chromate is formed when potassium chromate is added to a lead solution. It is a bright-yellow, amorphous powder, insoluble in the weaker acids, but readily soluble in potassium hydrate.

Lead is estimated quantitatively as a sulphide ; 100 parts of pure dried sulphide represent 93.31 parts of the oxide, or 158.37 parts of crystals of the acetate.

COPPER.

Copper is not a poison in the metallic state, and poisoning by its salts is comparatively rare. This substance occurs as a reddish-brown metal. It is soft and ductile, and has a specific gravity of 8.9. In a dry atmosphere the metal remains unaltered, but with moisture it becomes coated with the green carbonate of copper. It oxidizes, on heating, to black cupric oxide. The

strong acids dissolve it to form salts, but dilute hydrochloric or sulphuric acid has no effect. It forms alloys with metals.

Sulphate of copper (*blue vitriol*) is the result of the action of strong sulphuric acid upon copper. It is a blue, crystalline, efflorescent salt. When subjected to heat, it gives off its water of crystallization, and appears as a white powder. Sulphate of copper is principally used as an emetic in poisoning by phosphorus. This substance, in doses of half an ounce, acts as a powerful irritant. A child of sixteen months sucked some pieces of bluestone, and died in four hours. *Verdigris* (an impure subacetate of copper) is manufactured for paint. It is frequently formed in small quantities by allowing greasy substances to stand in copper saucepans. Half-ounce doses have acted fatally.

Symptoms.—Copper compounds produce the following symptoms: vomiting having a metallic taste; its color resembles that of bilious vomit, being greenish. There are usually purging, tenesmus, colicky pains, suppression of urine, and jaundice. In large doses the effects are of an irritant nature. Occasionally there are hæmaturia, gastro-intestinal inflammation, convulsions, paralysis, delirium, coma, and death.

Chronic poisoning is not very uncommon. The premonitory symptoms are languor, loss of appetite, constant thirst, giddiness, and a metallic taste. There may be muscular weakness, constant nausea, and the passages of loose stools of a dark color. Severe colic and local paralysis are rare. The color of the hair is sometimes changed to a greenish tint, and a green line may surround the gums.

Treatment.—Warm water should be administered, and, if necessary, the stomach-pump or tube used. The free administration of albumen and milk, mixed with sugar, is indicated. In chronic cases the cause must be sought for and removed.

Post-Mortem Appearances.—The surface of the body may present a yellowish tinge. Evidences of inflammation are found in the stomach and intestines. The mucous membrane may be ulcerated and bluish-green in color. Sometimes particles of the poison are found adhering to the coats of the intestines. The lungs, in some cases, are congested; in others ulcerations of the rectum exist; and in most instances the mucous membrane of the stomach and small intestines will be found thickened and inflamed, the stomach being softened, ulcerated, or even gangrenous.

Toxicological Examination.—Copper may be found in both a soluble and an insoluble state. Organic fluids in which the poison is present show a bluish-green color. The contents of the stomach or other organic matter should be destroyed with nitric acid and potassium chlorate. Repeated evaporations are to be carried on, as also extracting with nitric acid. Then evaporate any excess of acid, and dissolve the residue in hot water containing a drop or two of acid. This solution is then tested.

Tests.—*For the Soluble Salts:* (1) Potassium ferrocyanide gives a mahogany-colored precipitate. (2) Ammonia produces a blue color, and

metallic iron, on which metallic copper will be deposited from a solution. (3) Sulphuretted hydrogen produces with copper solutions a black precipitate.

The *quantitative* analysis of copper is determined as the black oxide; 100 parts equal 314.21 parts of crystallized sulphate.

ZINC.

Zinc in the metallic state is inert. It may be acted upon, if taken internally, by the gastric juices and be converted into a salt, which might occasion poisonous symptoms. These effects are likely produced by the sulphate and chloride. Zinc is a bluish-white metal, having a specific gravity of 7 to 7.2. It fuses at 412° C., and distils at about 1000° C., and is soluble in dilute acids, potassium or sodium hydrate on boiling, when it gives up hydrogen as with acids.

The zinc of commerce (*spelter*) may be contaminated with arsenic or other impurities.

Sulphate of zinc (*white vitriol*) occurs in rhombic crystals, and forms insoluble compounds with milk and albumen. As an emetic, in doses of twenty to thirty grains, it is rapid and non-depressing. In appearance it resembles Epsom salt and oxalic acid. It is a very mild irritant. Half an ounce to an ounce may be considered a poisonous dose.

The *chloride of zinc*[1] is a white, deliquescent, fusible substance. In strong solution it is known as Burnett's disinfecting fluid; and in a fifty per cent. solution it is called liquor zinci chloridi. Zinc chloride is a very painful caustic. Diluted it is employed as a soft injection for the preservation of dead subjects.

Fatal results have followed poisonous doses of this substance in four hours. (Taylor.) However, instances are on record where the case became chronic, lasting for years. Burnett's fluid has been taken by mistake for pale ale, magnesia, etc.

Symptoms.—The effects of the zinc salts are very similar to those produced by copper, though less powerful. There are a metallic taste in the mouth, vomiting of matters mixed with blood, pain in the œsophagus and abdomen, purging, feeble pulse, etc. The countenance is anxious, the body cold, and signs of collapse may supervene. As a usual thing the faculties remain clear.

The action of the *chloride* is that of a corrosive upon the mucous membranes. Froth may issue from the mouth, and there may result aphonia and blindness. The nervous system may be considerably affected. Death generally occurs as a result of the secondary effects, such as stricture of the œsophagus or pylorus, or by the chemical action of the poison on the mucous membrane of the stomach.

Treatment is similar to that proposed for copper-poisoning. Give

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[1] This substance is frequently used in solution in hydrochloric acid instead of borax as a soldering fluid, and when carelessly employed may cause poisoning.

albuminous drinks, and follow with tannin. Opium may be administered for pain.

Post-Mortem Appearances.—The lesions that are apt to follow the ingestion of the sulphate are of an inflammatory nature. The intestinal tract is inflamed, and the brain and lungs are usually congested. The chloride causes corrosion. Fatty degeneration of various internal organs may exist.

Toxicological Examination.—The fact must not be forgotten that zinc is used as an emetic, and, if discovered in the stomach contents, should not prevent the analyst from looking for other poisons. Boil the contents of the stomach with acetic acid. This dissolves any zinc oxides which are liable to be present in combination with animal matters. After this process the liquid should be filtered. Sulphide of ammonium is passed through the filtrate, causing a precipitate, which is sulphide of zinc. This should be collected and dried. Nitric acid is then added, the mixture being diluted with sufficient water. This is then neutralized with carbonate of ammonium and the appropriate tests applied.

Tests.—(1) In neutral solutions sulphuretted hydrogen produces a white precipitate. (2) Ferrocyanide of potassium gives a white precipitate. (3) Sodium carbonate, charcoal, and the blow-pipe give yellow precipitates, which change to white on cooling. The white crust, when heated with cobalt nitrate in the outer flame of the blow-pipe, produces a green color.

BISMUTH.

This substance is a reddish-white metal, with a specific gravity of 9.9. It is crystalline, and fuses at 267° C., and distils at white heat. Metallic bismuth is inert, and the less soluble salts are not actively poisonous when pure, as their power of absorption is difficultly accomplished.

Subnitrate of Bismuth.—*Pearl White, Magistery of Bismuth.*—This substance is largely employed in medicine; it is also used as a cosmetic. Medicinally it is administered in doses of from five to thirty grains. Large quantities are apt to produce toxic effects, the symptoms occasioned thereby being those of a violent irritant. These results may be due to the adulteration of the bismuth with arsenic.

Subnitrate of bismuth exists as a white powder, soluble in nitric acid, but insoluble in water. When a solution of bismuth and nitric acid is thrown in water, a white precipitate is formed, which blackens by ammonium sulphide, and is not soluble in tartaric acid.

The *symptoms* occasioned by toxic doses of this substance are those of an irritant, but, as stated above, they may be the result of contamination with carbonate of lead or arsenic.

Tests.—A black precipitate is given with sulphuretted hydrogen. Metallic bismuth may be reduced from its compounds before the blow-pipe as a brittle bead. It is stated that urine will show the presence of the sub-nitrate when a piece of paper saturated with a solution of potassium sulpho-

cyanide is placed in the solution and dried. A yellow spot appears at the point of contact.

TIN.

Tin is a silvery-white substance, of crystalline structure, soft and ductile, with the power of fusing at 228° C. The specific gravity of this metal is 7.3, and it distils at a white heat. Tin does not oxidize on exposure. The only preparations from a medico-legal point of view are the chlorides.

Symptoms and Treatment.—The salts of this metal act as irritants. The treatment consists in the administration of emetics and large quantities of milk and white of egg. A solution of the carbonate of ammonia is also serviceable.

Mode of Extraction.—Boil the organic fluids and tissues in water acidulated with hydrochloric acid, and filter. The filtrate should then be tested.

Tests.—The protochloride is thrown down by sulphuretted hydrogen, the precipitate being of a dark chocolate color. The gold chloride produces a beautiful purple precipitate, the *purple of Cassius*. A piece of zinc throws down metallic tin in an arborescent form. Sulphuretted hydrogen precipitates bichloride of tin, the color being yellow. It is insoluble in ammonia, and is thus distinguished from arsenic. It is known from the sulphide of calcium by being insoluble in hydrochloric acid.

IRON.

The only important salts of iron, medico-legally, are the ferrous sulphate and the ferric chloride. The former salt, also known as copperas, or green vitriol, is a crystalline substance; it is somewhat efflorescent, and loses its water of crystallization on heating, when it becomes a white powder. This product is then termed ferri sulphas exsiccatus, or dried sulphate of iron. Large doses of the sulphate are highly irritant, and have caused fatal results in several instances. Its action is very similar to that of the sulphate of copper.

The *chloride* is used in medicine in the form of tincture. Large quantities of it act as a violent corrosive poison. Ferric chloride is a brown deliquescent substance, very soluble in water, and has been administered with homicidal intent.

Symptoms.—The salts of iron have been used with the intent to procure abortion, particularly the chloride. The symptoms are those of an irritant poison. There are the usual pain in the stomach, violent purging and vomiting. The vomit is generally of a blackish hue.

The *treatment* consists in the use of the stomach-pump or tube, or emetics. Give diluents with alkaline carbonates.

The *post-mortem appearances* are those of an irritant poison. Black fluid may be found in the stomach and bowels.

Mode of Extraction.—Digest the organic matters thoroughly with

acidulated water,[1] filter, and evaporate to dryness. Incinerate the residue, and dissolve the ash in diluted sulphuric acid. Treat the solution with the appropriate tests.

Tests.—The fact must not be overlooked that iron is a constituent of the blood, forming an essential part of the hæmoglobin. This makes it difficult to distinguish between the natural and the foreign iron in the body.

The *ferrous* salts are of a light-green color, and in solution produce: (1) With alkalies, a white precipitate, which soon turns greenish brown. (2) With ferrocyanide of potassium, a white precipitate, changing from light blue to dark blue. (3) With ferrocyanide of potassium, a dark-blue precipitate. (4) A black precipitate with sulphide of ammonium. No precipitate is occasioned with sulphuretted hydrogen, sulphocyanide of potassium, or tincture of galls.

The *ferric* salts are of a reddish-brown color, and in solution give: (1) A Prussian blue with ferrocyanide of potassium. (2) With ferrocyanide of potassium, no particular precipitate, but the color is usually of a greenish tint. (3) With alkalies, a foxy-red precipitate. (4) With sulphuretted hydrogen, a precipitate of sulphur (white), and the ferric salts are transformed into the ferrous. A blood-red precipitate results with the sulphocyanide of potassium. (5) With the tincture of galls, a bluish-black precipitate is formed.

When examining the body of a person poisoned by iron it is well to observe whether there are any stains upon the garments or bedclothes. If so, they should be carefully examined for iron. The iron might be tested for in the fæces.

SILVER.[2]

The *nitrate* of silver is the only salt that needs reference to. This substance is soluble in equal parts of water. It crystallizes in colorless right rhombic plates, and turns black when contaminated with organic matters. It fuses, and can be cast in moulds or sticks (lunar caustic).

When taken internally, nitrate of silver acts principally as a corrosive poison. The administration of the compounds of silver for some time occasion a blue, indelible discoloration of the skin. Three or four fatal cases are on record of poisoning by this substance. The *symptoms* are occasioned by the irritant action of the poison, also by its effects upon the central nervous system. There may be convulsions, vertigo, coma, paralysis, and marked disturbances of the respiratory function. Death may result from asphyxia.

Chronic poisoning may occur when small doses of this salt are taken internally for some time.

The *treatment* consists in the administration of common salt, or chloride

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[1] Acetic acid should be used.

[2] The preparations of *gold* and *platinum*, with other metals of an allied nature, are irritant and corrosive, but rarely the occasion of poisoning.

of ammonium. Vomiting should be encouraged, and albumen or white of egg given. The symptoms are to be treated as they occur.

The *post-mortem appearances* in cases of *slow* poisoning show a bluish tint of the body. A blue line is sometimes observed in *rapid* cases around the gums. The intestines and stomach present either an intensely red color (inflammation), or they are white from the action of the salt, or black from the decomposition of animal matters.

Mode of Extraction.—The contents of the stomach should be boiled with bicarbonate of potassium, and filtered. The residue should then be boiled with nitro-hydrochloric acid, and again filtered. The filtrates should be mixed together and evaporated to dryness. This process chars the organic matters. Redissolve the residue in diluted nitric acid, and saturate with ammonia. Filtration should again be performed. The silver should then be thrown down with hydrochloric acid, in a solution acidulated with nitric acid.

Tests.—The use of this salt can be recognized by the white and afterwards black stains that appear upon the mouth, gums, skin, and clothing of the person. (1) Hydrochloric acid or soluble chlorides give a white, curdy precipitate, soluble in liquor ammoniæ. (2) Alkalies produce a brown precipitate, soluble in an excess of liquor ammoniæ. (3) Sulphuretted hydrogen gives a black precipitate, soluble in sulphide of ammonium. (4) The metal is thrown down white, with iron, mercury, and copper. (5) A yellow precipitate is given by tribasic phosphate of sodium. (6) Chromate or bichromate of potassium gives a brown precipitate.

CHROMIUM.

The most important of the chromium salts is the bichromate of potassium, which is largely employed for dyeing purposes. It has caused death in more than one instance. The chromate of potassium may also cause poisonous symptoms. In large quantities these salts are violent irritants; sometimes they act as corrosives to the mucous membrane of the alimentary canal. The chromates also act as local irritants, producing in those who work with them chronic ulcers and ozæna.

Symptoms.—In cases of acute poisoning these salts act as powerful irritants. Among the early symptoms is violent and constant purging, the stools being of a peculiar gray color, and the vomited matters yellowish. There may be very severe cramps in the legs, also extreme depression. The pupils are generally dilated, and the urine may be suppressed. Swelling and pain of the periosteum are usually present. The action of the substance is usually marked upon the mucous membranes. Two drachms have caused death in four hours.

Treatment.—The treatment calls for the use of emetics and magnesia, or chalk and milk. In chronic cases paint or sponge the throat with nitrate of silver.

Post-Mortem Appearances.—The lesions are those of an irritant

poison. The stomach is inflamed and destroyed, or it is marked with patch of a dark-red discoloration. The blood is thin and black.

Mode of Extraction.—The stomach and contents should be digest with hydrochloric acid, then boiled and filtered, and the filtrate tested. T solution in the stomach is usually of a red color; this may be a guide to i presence.

Tests.—(1) For the *chromous* salts sulphide of ammonium produces black precipitate, while for the *chromic* salts it gives a grayish-green pr cipitate. (2) Liquor ammoniæ for the *chromous* salts gives a blue precip tate, turning green; for the *chromic* salts liquor ammoniæ produces a grayisl green precipitate. (3) For the *chromic* salts silver gives a crimson precipitat

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CHAPTER VIII.

VEGETABLE IRRITANTS.

OXALIC ACID.

Sources in Nature—Symptoms—Treatment—Fatal Dose and Period—Post-Morte Appearances—Tests—Toxicological Examination.

Oxalic acid (*acid of sugar*) is one of the most important of poisons. exists in various plants, principally the sorrel. It may be artificially pr pared by the action of nitric acid on cellulose or sugar. The principal con pound of oxalic acid is potassium oxalate (potassium binoxalate).

From its cheapness, oxalic acid is frequently made use of in cases (suicide, but it is rarely employed as a homicidal agent, since it would l readily detected by its excessively sour taste. It has been the cause of acc dental death, from its being taken instead of Epsom salt (sulphate of ma nesium), which it much resembles.

In strong solutions, or in substance, oxalic acid acts as a corrosive, ar by absorption from dilute solutions as a neurotic poison.

Symptoms.—The symptoms depend to a certain extent on the size the dose and the degree of concentration. If half an ounce to an ounce the poison be taken, there is experienced at once a hot, acid, burning tas in the mouth. This is rapidly followed by tightness and pain in the thro extending to the stomach, accompanied by pallor, clammy perspiration, pro tration, abdominal pain, and vomiting. If the poison is in a diluted sta the latter symptom may be protracted for a quarter of an hour or so. some instances the vomiting has been incessant until death; in others the is little or no vomiting. Numbness and tingling of the legs have be noticed in some cases, which would go to show that this acid has a remo effect upon the nervous system. Spasmodic twitchings of the facial musc

have also been observed. These latter phenomena sometimes follow in cases of recovery from oxalic-acid-poisoning.

Treatment.—Magnesia, plaster from the walls, chalk, or carbonate of calcium should be given. The latter substance forms, with oxalic acid, oxalate of calcium, which is an inert substance. Vomiting should be encouraged by sulphate of zinc in doses of twenty grains, or by the hypodermatic injection of apomorphine. The use of the stomach-pump is to be avoided. Alkalies and their carbonates are also contraindicated, since the resulting compounds are poisonous.

Fatal Dose and Period.—The smallest quantity required to destroy life is one drachm. Half an ounce to an ounce may be regarded as a fatal dose. The period at which death takes place is variable. A case is reported by Ogilvie where fatal results followed the ingestion of the poison in three minutes. Death has occurred in ten minutes, but the great majority of cases prove fatal within an hour after swallowing of the substance. In other instances death has been protracted to the fifth day. The period of death does not depend upon the amount and concentration of the poison.

Post-Mortem Appearances.—The stomach, as a rule, contains a dark-brown, acid, mucous fluid ; it is usually contracted, and its mucous membrane pale, soft, and easily detached. Occasionally it is red and congested, blackened or gangrenous, or peeled off in patches. The small intestines may be inflamed. In some cases the pleura and peritoneum are inflamed and the lungs congested.

The mucous membrane of the mouth, pharynx, and œsophagus is white and shrivelled, and readily peels off. The œsophagus may also be in a state of contraction. Sometimes there are no well-marked lesions at all after death.

Tests.—The crystals of oxalic acid are four-sided prisms, colorless, and without odor. They are permanent in the air and are very acid. The acidity distinguishes them from the crystals of the sulphate of zinc and the sulphate of magnesia. When heated, the crystals melt and are dissipated without being charred, leaving no residue. This is a means of distinguishing oxalic acid from other crystals that are similar. Their solubility is reached in from eight to twelve parts of cold water. In *solution* this acid is recognized by the following tests :

(1) Nitrate of silver produces a white precipitate of oxalate of silver, which is soluble in nitric acid, and, when dried and heated on platinum-foil, detonates and evolves a white vapor. (2) Sulphate of calcium causes a white precipitate of oxalate of calcium, which is soluble in nitric or hydrochloric acid, but not in the vegetable acids. This substance will also throw down solutions of barium, lead, and strontium, but the sulphates of these bases are insoluble in nitric acid. (3) Cupric sulphate gives a faint bluish-white precipitate of cupric oxalate, which is almost insoluble in nitric acid.

Toxicological Examination.—The liquid contents of the stomach should be filtered at once if acid. If this condition does not prevail, they

should be digested with water before filtration. If the liquid contents are highly colored, they should be boiled some time with animal charcoal, being afterwards subjected to filtration. They are then evaporated to concentration, and acidulated with acetic acid and acetate of lead added. This precipitates oxalate of lead, which may be diffused through water. Sulphuretted hydrogen is then passed into it, when the lead will be thrown down as the black sulphide, the oxalic acid being liberated.

The urine should always be examined for an increase of the octahedral crystals of oxalate of lime. This is done by collecting the fluid in a conical glass and examining the sediment under the microscope. It should not be forgotten that these crystals may be detected in the urine of persons who have eaten food containing oxalic acid, such as sorrel and rhubarb.

Oxalic acid stains on cloth, etc., are discovered by boiling the material in water and applying the usual tests.

This acid is sometimes employed in cases of forgery for the purpose of removing ink. Traces of iron in the latter may be detected by the application of the ferrocyanide of potassium, which will turn it blue.

The *quantitative* estimation of oxalic acid is determined as oxalate of lead; every 100 parts of the dried oxalate equal 42.5 parts of the crystallized acid.

BINOXALATE OF POTASSIUM.—*Salt of Sorrel; Essential Salt of Lemons.*—The poisonous properties of this salt are due to the oxalic acid it contains. It is found in the leaves of the wood-sorrel, and is used for removing ink-stains, etc. Its effects are almost similar to those occasioned by the acid itself; and it has been taken by mistake, on account of its similarity to Epsom salt.

The common rhubarb plant contains considerable quantities of *oxalate of lime.*

TARTARIC ACID.

In large concentrated doses, tartaric acid acts as a powerful irritant, and may produce serious symptoms and fatal results. In a case reported by Tanner, a man swallowed an ounce of tartaric acid by mistake for a dose of an aperient salt. He suffered intense pain in the throat and stomach. Magnesia and soda were administered at once, but without relief, and the sufferer died at the end of nine days. The post-mortem appearances showed intense inflammation of the stomach and intestines.

ACETIC ACID.

Concentrated acetic acid is highly corrosive. Orfila mentions an instance of death rapidly following poisoning by this substance. Convulsions just preceded the fatal issue. The post-mortem examination revealed coagulated blood in the submucous areolar tissue of the stomach, which was interspersed with elevations of a black color, produced by this coagulation. The tongue and œsophagus were of a dirty-brown color. The mucous membrane of the

stomach was neither corroded nor softened, but the mucous membrane near the pylorus was almost of a blackish hue.

CARBOLIC ACID.

(Phenic Acid. Phenol.)

Carbolic acid, when anhydrous, is a colorless solid, with a characteristic smell. If five per cent. of water is added to it a liquid results. It turns red without deterioration if exposed to the light. Carbolic acid is a coal-tar product, whence the name *coal-tar creosote*. It is employed in surgery as an antiseptic, as it is a protoplasmic poison. Locally it causes a white eschar to appear on the skin, which produces a numbness. It coagulates mucous membranes, and at times is absorbed from wounds, thereby occasioning systemic effects. The toxic action is neurotic, and it is this effect which most frequently causes fatal results. When taken internally, undiluted, its effects are very energetic. It is rarely used as a homicidal agent, although it is frequently employed for suicidal purposes.

Symptoms.—When the acid is taken undiluted it acts as an irritant to the gastro-intestinal tract. It causes immediate vertigo and intoxication. These are accompanied by an intense burning pain in the mouth, throat, and stomach. There is vomiting of a frothy mucus. The pupils are invariably in a state of contraction, the conjunctiva being insensible to touch. The pulse is intermittent and rapid, and the skin is cold and clammy. The characteristic odor of the poison is detected in the breath and vomit. Complete suppression of the urine may supervene, or it is smoky and dark-colored. There may be intense coma and convulsions. The patient frequently dies from syncope, or, if prolonged, from apnœa.

The external application of the acid has produced many of the above-mentioned symptoms. Fatal results have followed its use as an injection.

Treatment.—Death is usually very rapid, so that little time is left for treatment. The best antidotes are castor oil, olive oil, saccharated lime, and magnesia. Emetics are of little use, on account of the anæsthesia of the mucous membrane of the stomach. To counteract collapse the injection of stimulants may be tried.

Fatal Dose and Period.—Death takes place usually in from thirty minutes to four hours after the administration of the poison. The shortest time in which fatal results have taken place was ten minutes, and the longest sixty hours.

Dangerous symptoms have followed six or seven drops or grains of the poison; but the usual deaths have been caused by one or two ounces. This quantity, however, is much greater than is required to prove fatal.

Post-Mortem Appearances.—The mouth, throat, œsophagus, and stomach are whitened and sodden. The mucous membrane of the same is readily removable. Reddening (inflammation) is noticed between the folds of the stomach. The brain is occasionally in a state of congestion, fluid

being present in the ventricles. The stomach may be thickened and contracted. It is often intensely congested, and the mucous membrane detached or destroyed. The lungs are usually filled with blood, and the left ventricle of the heart is contracted, while the right is flaccid. The smell of the acid is readily perceived in the stomach and occasionally in the intestines or other viscera. The blood is fluid and dark-colored. The bladder is usually in an empty state.

Tests.—The odor of the acid is the most characteristic test. (1) When it is acted on by nitric acid, yellow crystals of picric acid are formed. (2) A whitish-yellow precipitate is formed in a weak solution of carbolic acid by bromine water. (3) It precipitates albumen and collodion. (4) A violet color is developed when neutral perchloride of iron is added to the acid. (5) Solution of ammonia and of chlorinated soda produce a deep-purple coloration. (6) Millon's reagent (mercurous nitrate and nitric acid) gives with it a red color when warmed. This latter test detects 1 in 200,000.

Toxicological Examination.—The odor of the acid will be perceived in the body after death. Unless it can be detected, tests are likely of no avail. For the recovery of the acid the organic matters should be distilled along with dilute sulphuric acid. The urine should also be examined.

CROTON OIL.

(Croton Tiglium.)

Croton oil is a fixed oil obtained from the seeds of Croton tiglium (nat. ord. *Euphorbiaceæ*), a tree of India, the active principle of which has not been isolated. This oil has proved fatal as a powerful irritant to the gastro-intestinal mucous tract, occasioning vomiting and purging, followed by collapse, resembling severe cases of cholera.

Croton oil presents a light-yellow color, and has an unpleasant odor. Its taste is burning and acrid. The seeds of the plant are of a dull, dirty appearance.

At Mount Holly, New Jersey, a woman was found guilty of attempting to poison her son for the express purpose of obtaining his life insurance.[1] The defendant claimed that she had purchased and used the oil for the cure of her corns.

When croton oil is applied to the skin, it acts as an intense irritant, producing a papular eruption which soon becomes pustular. Internally it is a rapid and powerful hydragogue cathartic, causing griping pains, and occasionally depressing the circulation. In toxic doses it causes great depression and frequently ends fatally.

Analysis.—The oil should be separated from the stomach contents by ether. The solution should then be allowed to evaporate spontaneously, when the resulting oil is tested with nitric acid and heat.

[1] The *Vandergrift case*. In this case the croton oil was administered in successive doses, which were small, so as to cause gastro-enteric symptoms.

ELATERIUM.

This substance is obtained from the juice of Ecbalium officinarum (*wild or squirting cucumber*). It is employed in medicine as a drastic hydragogue purgative, also proving diuretic, and in large doses often causing fatal results. Its action, or effects, is very similar to croton oil. Violent effects have been produced by one grain of this substance. It is unaffected by nitric acid, but sulphuric acid gives it a reddish-brown color. The active principle of elaterium is *elaterin*, a neutral substance, to which the poison owes its activity.

CASTOR-OIL BEANS.

These are obtained from the Ricinus communis. From them are obtained, by pressure, the castor oil of commerce. The action of the seeds upon the stomach and intestines is that of an irritant poison, the *active principle* being due to the oil. Three seeds proved fatal to an adult male in forty-six hours, and twenty seeds destroyed life in a lady in five days. The symptoms presented in these cases were similar to those occasioned by cholera.

COLCHICUM.

Colchicum is the *corm* and *seed* of Colchicum autumnale, or meadow saffron (nat. ord. *Liliaceæ*). It is a native of Europe, and contains a powerful alkaloid principle, *colchicine*, which is converted into *colchicein* by the action of the mineral acids. This alkaloid resembles veratrine in some of its properties; it is found principally in the bulb of the plant, but exists also in the seeds.

In medicine, colchicum is used as an alterative, diuretic, and cholagogue.

Symptoms.—Large doses of colchicum cause burning pain in the throat, œsophagus, and stomach. These are supplemented by great thirst, soreness, vomiting and purging, cramps, dilated pupils, cold, collapsed skin, suppression of the urine, and rapid exhaustion. Delirium and convulsions may take place.

Treatment.—The treatment calls for the employment of emetics and cathartics. As a partial antidote, tannic acid should be given, as well as demulcents, to protect the surfaces of the stomach. Opium and stimulants are indicated to counteract the resulting depression.

Fatal Dose and Period.—Death usually follows the administration of the drug within twenty-four hours, although it has occurred in seven hours, and again has been protracted for several days. Less than half a grain of the alkaloid is fatal.

Half an ounce of the seeds have caused death, while, on the other hand, half an ounce or less of the wine of the root and forty-eight grains of the dried bulb proved fatal. A party of nine persons, who had partaken of what they supposed was ordinary wine, but which was colchicum wine, were seized in a few hours with nausea, vomiting, purging, excruciating pains, cramps,

and prostration. Five out of the number died within thirty-six hours. (Occurred in Montreal, 1873.)

Post-Mortem Appearances.—There is generally inflammation of the stomach and intestines. The pia mater may be congested, and the lungs are usually inflamed. In some instances the post-mortem appearances are normal.

Analysis.—Colchicine is soluble in water, and has a feeble alkaline reaction and a bitter, acid taste. It occurs in white crystals. With nitric acid it produces a violet color, which afterwards changes to blue and brown. Sulphuric acid produces no effect, and this fact distinguishes it from veratrine.

It is recovered from organic matters by a modification of Stas's process.

SAVINE.

Savine is the tops of Juniperus sabina (nat. ord. *Coniferæ*), an evergreen shrub of Southern Europe. It contains a volatile yellow oil which may be procured by distillation. It is employed in medicine in the forms of powder and oil, both of which are powerfully irritant. When applied locally, savine acts as an irritant, and when administered in toxic doses it produces great depression, unconsciousness, convulsions, and hemorrhages from the uterus and kidneys. There are usually suppression of the urine, and, in the pregnant female, abortion. Savine is seldom used as poison, but it is frequently employed as an abortifacient.

Death is often delayed for several days, or the patient may die in fifteen or sixteen hours after the ingestion of the poison.

Post-Mortem Appearances.—These are usually congestion of the capillary and venous systems. The heart is full of blood, especially on the right side. The color of the blood is black. There seems to be a general plethora of the vessels of the intestinal system.

Toxicological Examination.—When powdered savine has been taken, the color of the stomach contents will probably be of a greenish tint, and the coniferous structure of the herb will become apparent under the microscope. The organic matter in the stomach should be distilled. The distillation should then be agitated with ether, in which it is soluble, and evaporated. The poison is recognized by its odor.

HELLEBORES.

Black Hellebore.—*Helleborus Niger.*—This substance is a powerful irritant to the stomach and intestines. It has caused fatal results when given in overdoses, producing vomiting (which is violent), purging, cold sweats, abdominal pain, collapse, and convulsions. This poison was formerly named *melampodium.*

White Hellebore.—*Veratrum Album.*—Violent sneezing is caused by the powder. When taken internally the following symptoms are manifested: a burning heat and constriction of the throat, great anxiety, abdominal pain, nausea, vomiting and purging, and great prostration. The pulse is feeble

the pupils dilated, trembling in the limbs is apparent, the body is bathed in cold sweats, and the patient soon passes into insensibility and death. Death may occur in from three to six hours. The active principle of this substance is *veratrine.*

Green Hellebore.—*Veratrum Viride; American Hellebore; Indian Poke.*—This plant contains two alkaloids, *veratroidine* and *jervine*, to which its effects are due. Other alkaloids are *rubijervine* and *pseudojervine.* Poisoning rarely occurs, as an overdose produces emesis. Dangerous symptoms do frequently arise, and the ingestion of a toxic dose has proved fatal in several instances. The tincture is a very powerful cardiac depressant, diminishing the frequency and force of the contraction of the heart. Treatment consists in the administration of alcoholic and other cardiac stimulants.

VERATRINE.

This alkaloid is obtained from the seeds of Asagræa officinalis (nat. ord. *Liliaceæ*), a Mexican plant. It also exists, as above mentioned, in *V. album* and *V. viride.*

Large doses of this alkaloid produce vomiting and purging, muscular weakness, with a cold and clammy skin. The pulse is weak, irregular, and rapid, and there are muscular tremors. At first veratrine appears to stimulate the excito-motor cardiac ganglia and muscle, temporarily increasing the pulse, but this soon changes to depression and paralysis of both. The vasomotor centres are first stimulated, then depressed. Finally the respiratory centre is paralyzed, and the result is death.

Veratrine is eliminated chiefly by the skin and kidneys, increasing their secretions. The one-sixteenth of a grain has caused dangerous symptoms in the human subject.

Treatment.—The stomach-pump or emetics and powdered charcoal should be used. The use of tannin and stimulants is indicated. Opium combined with purgatives is beneficial.

Tests.—(1) When veratrine is applied to the nostrils it induces violent and uncontrollable sneezing. It possesses no smell. (2) It is turned yellow, and then crimson, by sulphuric acid. The red color appears at once when the acid is gently heated. (3) It is changed to a light red by the action of nitric acid. (4) When warmed in concentrated hydrochloric acid a dark-red color is the result. This resembles a strong solution of potassium permanganate (Trapp's test).

Toxicological Examination.—Veratrine should be separated from organic mixtures by a modification of Stas's process. The chloroform extract is then tested by sulphuric acid.

YELLOW JASMINE.

Yellow jasmine (*Gelsemium sempervirens*) is used in medicine in the form of the rhizome and rootlets of the yellow or Carolina jasmine (nat. ord.

Loganiaceæ), a climbing plant of the Southern States. It owes its effects to an alkaloid, *gelsemine*, combined with *gelseminic acid*.

Symptoms.—Toxic doses cause extreme muscular weakness, partial blindness, dilated pupil, often internal strabismus, incoördination, ptosis, feeble pulse, and occasionally spasms of the throat. The jaw drops, articulation is impaired, and general sensibility much impaired or diminished. The respiratory function is slowed, the temperature declines, and a profuse sweat covers the body. Death takes place from respiratory failure. The mind is generally clear to the last. The poison appears to depress the heart directly. Mydriasis with paralysis of accommodation and ptosis are caused by the paralyses of the end organs of the motor oculi nerve. This action must also affect the sixth nerve, as the external rectus muscle is somewhat enfeebled.

Treatment.—The stomach should be speedily evacuated, and followed by stimulants, both internal and external. Morphine hypodermatically is recommended ; also electricity.

Fatal Dose and Period.—The fluid extract is four times stronger than the tincture, both of which preparations are official. A child of three years was killed by twelve minims of the fluid extract. Thirty-five drops of the tincture have produced fatal results in an hour and a half. Death has occurred in an hour or more.

Tests.—(1) When pure, sulphuric acid dissolves gelsemine without any change of color ; as commonly found, however, its color is changed to a brownish hue, and, if warmed, to a purple. (2) A fragment of bichromate of potassium stirred in the acid solution produces a red color, which soon changes to blue. This reaction is distinguished from that of strychnine by the action of nitric acid, which gives to gelsemine a bluish-green color when evaporated. It does not affect strychnine.

Toxicological Examination.—Gelsemine and gelseminic acid may be extracted from organic mixtures by the process recommended for the alkaloids. The filtered solution should then be shaken with ether to remove the gelseminic acid. The residue is rendered alkaline and extracted by ether and chloroform to procure the gelsemine.

POISONOUS MUSHROOMS.

Symptoms.—The usual symptoms are those of narcotic irritants, such as violent vomiting, purging, abdominal pain, anxiety, thirst, etc. These may appear within an hour. Death usually takes place in a day after the poisonous fungus has been given.

Treatment.—Administer an emetic, such as sulphate of zinc, or use the stomach-pump. Castor oil should also be given.

Post-Mortem Appearances.—The stomach and intestines are usually found to be inflamed or even gangrenous.

Carefully search the stomach for the gills and spores of the suspected mushroom. The fungus should be identified.

CHAPTER IX.

ANIMAL IRRITANTS.

CANTHARIDES.

(Spanish Flies.)

Cantharis vesicatoria is an insect found in different parts of Europe, but especially in Spain. It is used extensively in medicine, both externally and internally. When dried, cantharides contain a volatile oil and a neutral crystalline principle, *cantharidin*, which is the vesicating principle. Cantharidin also exists in cantharis vittata, or the potato fly, which is frequently substituted for the Spanish fly.

When applied to any surface, cantharidis acts as an intense irritant, and, in contact with the skin, produces an inflammation which often results in a serous effusion under the cuticle. If the application be long continued, gangrene may result and constitutional effects be manifested. The one-hundredth of a grain of the active principle may raise a blister on the lips.

Symptoms.—It acts as an irritant to the gastro-intestinal tract, causing vomiting and purging, burning heat in the stomach, pain in the loins, and great thirst. The vomit may be mixed with bloody mucus and shreds of membrane. There is constriction and difficulty of swallowing and dryness of the fauces. Then there is an incessant desire to urinate, which is attended with severe pain and the voiding of but a few drops of bloody urine. This is accompanied with tenesmus. Priapism occurs in males, and heat and swelling of the labia in females. Sometimes there is faintness, with giddiness and delirium, the patient soon passing into convulsions and death. The stools frequently contain shiny golden or green particles, which are remnants of the wings of the insect. If the tinctura cantharidis has been taken, the symptoms develop very rapidly.

One ounce of the tincture and twenty-four grains of the powder have caused death. The fatal period is usually stated at from twenty-four to thirty-six hours.

Treatment.—There is no known antidote. Emetics and thick warm liquids should be given. The administration of cathartics (castor oil), opium, and stimulants is advisable.

Post-Mortem Appearances.—Intense inflammation of the mucous membrane of the stomach and intestines. The mouth, œsophagus, and throat, together with the ureters, kidneys, and bladder, are also inflamed. Congestion of the brain has been noticed in some instances. If the powder has been taken, the shiny green particles can be distinguished in the stomach and bowels.

Tests.—An extract of the suspected materials should be made, and

treated by digesting with ether or chloroform until exhausted. This di solves out the active principle, cantharidin. The ethereal solution is the evaporated until almost dry, when the few drops that are left should be ap plied on lint to the lips or the forearm, and covered with isinglass plaster c gold-beaters' skin, when the resulting vesication is the test of the presenc of the cantharidis.

POISONOUS FOODS.

Certain animal foods are frequently found to produce poisonous symp toms, either owing to idiosyncrasy (for only a single person out of sever may be affected) or depending upon the action of some noxious agent i the organic matter of the food itself, either introduced for homicidal pu poses or of bacterial origin.[1] Such cases occasion symptoms of a violer nature, and are of some importance to the medical jurist on account of the poisonous effects.

Sausage Poison.—The poisonous effects of sausage-meat are suppose by some to depend on a peculiar fatty acid (*batrolinic acid*), which is capabl of developing in cured and dried sausage. A more recent theory, howevei is that the presence in the meat of an entozoon named *trichina spiralis* i the cause of the so-called sausage-poison. (*Vide* Trichina Spiralis.)

In other cases there is generated in *uncured* sausage-meat a *ptomaïn* developed by the action of bacterial growths, and this may be the cause o the untoward symptoms of the poison.

The symptoms thus occasioned might give rise to unfounded charges o criminal poisoning, or be attributed to poisoning by one of the mineral irri tants. The examination of the suspected food, or of a piece of a muscle o a living or dead subject, both microscopically and chemically, will generall demonstrate the true source of the trouble.

Cheese Poison.—This common article of food frequently gives rise t symptoms of poisoning very similar to those occasioned by the ordinary irritants. The cause of the peculiar effects shown after the ingestion of suc food is unknown. By some it was ascribed to a putrefied state of the curd Again, it has been supposed that the poison is derived from an imprope fermentation of the milk. Professor Vaughan, of Michigan, claims that it i due to a ptomaïne to which he has given the name *tyrotoxicon*. This recer discovery appears to be the true source of the disorder.

Poisonous Fish.—It is a well-known fact that certain individual through idiosyncrasy, are poisoned after eating various kinds of fish. Seve symptoms arising from an irritation of the gastro-intestinal tract, somewh resembling cholera morbus, are developed. This poisonous action, ho ever, cannot be referred in all cases to idiosyncrasy. Of all the varieties shell-fish, *mussels*, which are extensively employed in various parts of Euro as food, occasionally produce very alarming symptoms. The poisono action of this shell-fish seems to be due to a specific ptomaïne, *mytilotoxin*

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[1] *Vide* Ptomaïnes.

discovered by Brieger. The action of this substance somewhat resembles that caused by curarine.

The *symptoms* in some cases are those of a simple irritant, such as nausea, vomiting, purging, cramps, etc. In other instances the nervous symptoms are well marked, while the gastro-enteric disturbances are slight. Of these nervous symptoms, delirium, insensibility, loss of muscular power, coma, dyspnœa, and convulsions are conspicuous. Again, an eruption similar to urticaria, together with asthma, frequently appear.

Pickled salmon and herrings have produced poisonous symptoms.

Putrid Meat.—The symptoms occasioned by decayed meat are both of a gastro-enteric and typhoid character, or septicæmia. (*Vide* Dissecting Wounds.) Partial decay also renders meat unfit for food. The nature of the poison is probably due to one or more poisonous ptomaïnes. Much of the meat sold to the poor of this city is unwholesome, being in a state of decay, and totally unfit for human food.

Poisoned Meat.—Persons are often poisoned by having partaken of the flesh of various animals or birds which have fed upon such deleterious substances as datura stramonium, the leaves of kalmia, or grain which has been steeped in a solution of arsenic previous to planting. Cows and goats frequently feed upon the first-mentioned plant, and cause poisoning in those who drink their milk. Kalmia, or laurel, leaves and buds are common food for the pheasant.

TRICHINA SPIRALIS.

The seat of this microscopic entozoon is in the muscular tissue of the body. It exceeds in minuteness of form and in numbers every other parasite. The minute worm exists coiled up within an oval cyst, appearing to the naked eye as a tiny white speck. When found in the muscles, it is generally in those that are superficial, the affected muscles being of a pale reddish-gray color, and the trichinæ, which exist in all stages of development, being scattered about within the muscular-fibre sheaths. Trichinæ have been found in the substance of the heart itself.

The source of the parasite is from raw or imperfectly cooked pork or sausages. After the introduction of the ova into the stomach, trichinæ develop at once, the embryos passing into the intestines, from which they progress to the muscular tissue of the body. The parasite is perfectly harmless while enveloped in its capsule.

Symptoms.—These are manifested by great depression, lassitude, loss of appetite, and sleeplessness. Fever follows, with muscular pains of great severity, and sometimes œdema of the face and eyelids, swelling of the joints, followed occasionally by severe contractions of the flexor muscles of the extremities. Diarrhœa is often an early symptom. Again, typhoid disturbances supervene, and the patient dies in an unconscious state.

In fatal cases, trichinosis produces its effects within a month after the ingestion of the parasite.

Treatment.—There is no known remedy for trichinæ. Santonin ma be tried. Avoid raw or imperfectly cooked pork.

Microscopic Examination.—The form of the trichina spiralis is ex pressed in the name. It is found within the sarcolemma of the muscula fibres. It possesses an alimentary canal. When removed from its cyst, thi parasite measures about one-thirtieth of an inch in length, and about one seven-hundredth of an inch in diameter.

CHAPTER X.

CLASS II.—NEUROTIC POISONS.

ORDER I.—CEREBRAL NEUROTICS.

(1) *NARCOTICS.*

OPIUM AND MORPHINE.

Remarks—Symptoms—Treatment—Fatal Dose and Period—Diagnosis—Post-Mortem Appearances—Tests—Toxicological Examination—Failure to detect the Poison.

Opium is the concrete milky exudation of the unripe capsules of the *Papaver somniferum*, or white poppy (nat. ord. *Papaveraceæ*), a native of Persia, but cultivated throughout the world. It is a very complex substance, being composed of various constituents, such as alkaloids, resin, gum, coloring matter, oil, etc. Its principal properties are due to morphine ($C_{17}H_{19}NO_3$), an alkaloid which crystallizes in truncated prisms, of an alkaline reaction, combining with acids to form salts. The chief salts of this alkaloid are the acetate, the sulphate, and the hydrochlorate, which are soluble in water and alcohol, but insoluble in acetic ether. Morphine itself is insoluble in ether and chloroform, very little in water, more so in alcohol, and also in acetic ether. It is also soluble in the saliva and gastric juices. Therefore, if at any time of the ingestion of the drug the individual's saliva and gastric juice do not happen to be flowing freely, he may take without apparent harm a much larger quantity than would be necessary to kill him if these juices were being freely secreted.

Other opium alkaloids are codeine, narceine, narcotine, thebeine, papaverine, pseudomorphine, laudamine, hydrocotarnine, cryptopine, porphyroxine, meconine, etc., united with meconic acid as meconates in the natura state. Meconic acid is characteristic of opium alone.

The proportion of opium and morphine in different specimens range from six to fifteen per cent. Dried pulverized opium should contain fro thirteen to fifteen per cent., while in its normal moist condition not less tha nine per cent. is required by the United States Pharmacopœia. Of th

other alkaloids, they form together from four to ten per cent. by weight of the opium.

The various preparations of opium and morphine with their strength are as follows :

Opii pulvis (*powdered opium*) contains not less than twelve nor more than sixteen per cent. of morphine.

Opium denarcotisatum (*denarcotized opium*) contains fourteen per cent. of morphine.

Pilulæ opii (*opium pills*) contain each one grain of powdered opium.

Trochisci glycyrrhizæ et opii (*troches of glycyrrhiza and opium ; Wistar's cough lozenges*) contain each one-twentieth of a grain of the extract of opium.

Pulvis ipecacuanhæ et opii (*powder of ipecac and opium ; Dover's powder*) contains opium and ipecac, of each one grain, with sugar of milk.

Tinctura opii (*tincture of opium ; laudanum*) contains ten per cent. of opium.

Acetum opii (*vinegar of opium ; black drop*) contains ten per cent. of opium.

Tinctura opii camphorata (*camphorated tincture of opium ; paregoric*) contains four-tenths per cent. of opium.

Magendie's solution contains sixteen grains of sulphate of morphine to the fluidounce.

In addition to these preparations, there are numerous patent medicines rich in opium or morphine which have proved fatal. Such are Mrs. Winslow's Soothing Syrup (containing about as much as one grain of morphine to the ounce), Godfrey's Cordial (containing about one grain of opium in two ounces), and Dalby's Carminative (containing one grain in six).

The action of the alkaloid morphine differs from opium in that it is less of a diaphoretic, less constipating, and about four to six times as active in other respects. The effects of both these drugs are so nearly alike—those of energetic poisons—that they will be considered together in this work.

In the years 1876 to 1880 over forty per cent. of all the cases of poisoning in England were due to opium. (Blyth.) Of these, three hundred and ninety-three were males and two hundred and fifty females, and out of the total number there were but two cases of homicide ; the rest—twenty-two and four-tenths per cent. of the female cases and thirty-six and five-tenths per cent. of the male—were due to self-destruction. Out of nine hundred and seventy-seven accidental deaths in New York City from 1870 to 1891, inclusive, one hundred and seventy-nine were poisoning by opium or its alkaloid.

Symptoms.—The symptoms of opium and morphine, as already stated, are essentially the same ; the latter drug, however, acts more rapidly and tends to produce convulsions more frequently than does opium. This is especially the case with infants. The first appearance of the symptoms will depend on the size of the dose, the condition of the stomach at the time of administration, and the form of the poison. The symptoms usually show themselves after a large dose in about twenty or thirty minutes. They begin with giddiness and confusion, soon followed by great drowsiness and an irre-

sistible inclination to sleep. The breathing is slow and stertorous, the respirations frequently not exceeding two or three a minute. The pulse may be unaffected or at first slow and full, but toward the end it becomes rapid, feeble, or irregular, and often scarcely appreciable to the touch. The pupils are minutely contracted (pin-hole), and it is well to recollect that other alkaloids, such as eserine, aconitine, and strychnine, produce the same effect, but the general symptoms occasioned by them are different.

Often an intense itching of the nose is present, being a symptom of great value in the diagnosis of opium-poisoning. In some cases the skin is cold and livid; in others it is bathed in a profuse perspiration. The muscular system is generally in a relaxed condition. Vomiting sometimes occurs.

In the later stages of the poisoning it is with the greatest difficulty that the patient can be aroused, and at last he passes into complete coma, with pallor and a ghastly countenance. Death may occur through sudden heart-failure, and it is often preceded by convulsions, especially in children or infants.

The *external* application of opium and morphine, especially to an abraded surface, and even to the sound skin, has proved dangerous, and even fatal. Death has followed the administration of the drug by the rectum or hypodermatically.

Treatment.—The first object is to remove the poison from the stomach as speedily as possible by means of the stomach-pump or tube, or by an emetic, as mustard-water, or sulphate of zinc. If no emesis is induced by these in a short time, they must be abandoned. It is important to wash out the stomach with strong tea. The absorption of the poison may be retarded to a certain extent by the administration of tannic acid, solution of iodine, or pulverized charcoal. Use faradism and artificial respiration, flagellation with wet towels, to keep up respiration by reflex irritation, best applied to the region of the trigeminus. Keep the patient moving about and awake. The administration of strong coffee enemata with brandy is indicated. Atropine is good as a respiratory stimulant. It may be given hypodermatically in one-sixtieth of a grain doses, repeated in half the amount at the end of fifteen to thirty minutes if required, the guide to its administration being regulated by the respiration. Strychnine, cocaine or caffeine, and potassium permanganate are also recommended.

Fatal Dose and Period.—It is well known that some individuals are always more susceptible to the influence of the drug than others; also that beginners can only stand a small quantity at first, but when they become accustomed to it they can take, without serious results, doses which at first would have surely proved fatal. Even the confirmed *habitué*, who imagines himself "proof" against anything but the largest quantities, may some day end his existence by a dose smaller even than he has frequently taken before. This peculiarity is probably due to the fact that at the time of the ingestion of the poison the stomach glands were actively secreting juices of a more

acid nature than usual. By this means the drug is assimilated into the blood much more rapidly and thoroughly than usual, and the result is disastrous.

Children and young infants are very susceptible to the effects of opium and morphine. Two or three drops of laudanum have caused death in very young infants. The narcotic effects may be transmitted to the child through the milk of a mother who has taken the drug. The tenth and twelfth part of a grain of opium have respectively proved fatal to infants two and five days old. There is a case recorded where about the twelfth of a grain (one drop of laudanum) resulted in death in an infant seven days old. The child was in a comatose condition up to the time of death, some eighteen hours. On the other hand, children sometimes recover from very large doses of the drug.[1]

The average minimum fatal dose of opium for an adult is about four or five grains, but persons have survived much larger quantities. The system may soon acquire a tolerance for the poison by habit, and enormous quantities can be taken without apparent effect. Thus, De Quincey accustomed himself to the daily use of nine ounces of laudanum, an equivalent to three hundred and sixty grains of solid opium. The habitual employment of this drug, however, is extremely injurious to the human system, especially in the form of opium-smoking.

The average period at which death takes place from opium-poisoning may be stated at from seven to twelve hours. The shortest recorded period is three-quarters of an hour, while, on the other hand, death has been protracted for twenty-four or forty-eight hours. The chances of recovery are good if the patient survives twelve hours.

One grain of morphine has proved fatal, and, hypodermatically, one-sixth to one-half of a grain. Again, enormous quantities have been taken without serious results; thus, two drachms of morphine were taken by a person without causing death.

The symptoms of morphine-poisoning come on in from fifteen to thirty minutes to an hour or three-quarters. Death may take place within forty-five minutes, but usually not before eight to ten hours.

Diagnosis.—In diagnosing the effects of poisoning by opium from those due to apoplexy, epilepsy, etc., it is to be remembered that in apoplexy, involving the pons Varolii, the pupils are also contracted as in opium-poisoning. Other important diseases or conditions to be kept in mind are acute alcoholism, uræmic coma, and poisoning by chloral and other narcotics. It is extremely difficult, if not impossible, to diagnose opium-poisoning from the symptoms alone; and even with the post-mortem evidences the exact nature of the case is fraught with difficulties. Unless the evidence from the toxicological examination is clear and unequivocal, particularly if

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[1] The writer saw a case of accidental poisoning by morphine in a new-born child. One-quarter of a grain was the quantity administered, and the infant lived several hours. (*Farace case.*)

the history of the case is obscure and the post-mortem appearances negative, no definite conclusion can justifiably be reached.

Post-Mortem Appearances.—These are not very characteristic. There is usually a turgid state of the vessels of the brain, with an effusion of serum into the ventricles and at the base. The lungs and other vascular organs may be in a state of congestion. There may be heart-clots in both sides of the heart, and thrombosis of the pulmonary artery. These changes, when present, are not characteristic of death from this poison.

Tests.—Opium itself has no direct chemical test. But, as every watery solution contains the meconate of morphine, well-marked reactions are used to distinguish the alkaloid of opium, morphine, and its peculiar acid, meconic.

I. *Morphine.*—The important tests for this alkaloid are the nitric acid, ferric chloride, sulphomolybdic acid, and iodic acid.

(1) *Nitric Acid Test.*—With morphine and its salts concentrated nitric acid produces a rich orange-red, slowly fading to yellow, or sometimes a brownish-yellow color, which upon standing strikes a light yellow. Nitric acid also produces a reddish color with other organic substances, but these are not crystalline. It strikes a deep-red color with brucine, which upon the addition of stannous chloride is changed to a bright purple; no such change is produced in the case of morphine.

(2) *Ferric Chloride Test.*—This chemical, also the sulphate, strikes with morphine or its salts a deep-blue color, which slowly changes to a dark greenish blue, which is destroyed by free acids, by alkalies, and by heating. With ferric chloride, salicylic acid, carbolic acid, gallic acid, and various forms of tannin produce a bluish color. These substances are all soluble in water or ether. It is important, therefore, to remove them from the suspected matter before making use of the ferric chloride test.

Nitric acid destroys the blue color produced by ferric chloride, forming a reddish-yellow mixture. This is occasioned by the action of the acid on the alkaloid. Ptomaïnes do not produce any morphine reaction with this test.

(3) *Sulphomolybdic Acid Test.*—This reagent is prepared by dissolving five or six grains of molybdate of sodium or ammonium in two drachms of strong sulphuric acid. If morphine is treated with this acid, it strikes a beautiful violet color, changing to green, and finally to a sapphire-blue. A similar reaction is produced by a few glucosides and papaverine. The foreign matter that usually exists in complex organic mixtures may interfere with the success of the test; therefore the material to be examined should be thoroughly purified before applying the test. The sulphomolybdic acid test is also known as *Froehde's test.*

(4) *Iodic Acid Test.*—Iodic acid is reduced by morphine, rendering the color of the solution brownish, from the free iodine. If starch is present, a blue color is formed by the formation of iodide of starch. If the liquid is treated with chloroform, the latter dissolves the iodine and assumes a purple color. Other substances produce this reaction, however, but the value of the reaction is principally as a negative test.

Other tests for morphine are employed, and are sometimes useful, but e four reactions just mentioned are the important ones used to distinguish orphine. Among the different tests for this alkaloid are the following: dine in iodide of potassium, terchloride of gold, and bromine in hydro-romic acid.

II. *Meconic Acid.*—Pure meconic acid occurs in the form of colorless rystals, and is somewhat sparingly soluble in cold water, but more so in lcohol. This acid is found in no other substance than opium; therefore its iscovery affords positive proof of the existence of that drug.

(1) *Ferric Chloride Test.*—Meconic acid gives with ferric chloride a deep-ed color; this is also true of the salts of this acid. This red color is extinguished by stannous chloride, but not by corrosive sublimate, nor by any free mineral acid in excess. A similar color is produced by the sulphocyanates, such as found in the saliva, and consequently in the stomach; but the color of the meconate is not discharged by chloride of gold or corrosive sublimate, while that of the sulphocyanates is. A red color is also produced by strong acetic acid and most of its salts, but the free mineral acids destroy it more readily than that occasioned by meconic acid.

(2) *Lead Acetate Test.*—When meconic acid is treated with a solution of acetate of lead, meconate of lead is thrown down as a yellowish-white precipitate. This precipitate is insoluble in acetic acid. If the ferric chloride test is applied, a deep-red color results.

Lead acetate produces a white or yellowish-white precipitate with sulphuric acid, sulphocyanic acid, tannic acid, citric acid, etc., either *free* or combined as salts. These latter generally fail to produce the red color that ferric chloride gives with meconic acid, or they are soluble in excess of acetic acid.

Toxicological Examination.—The presence of opium in the contents of the stomach, the vomit, or the tissues may be considered certain if the chemical analysis shows the existence of either meconic acid or the principal alkaloid, morphine. Therefore, when opium is suspected to have been administered, the duty of the toxicologist is to examine for both meconic acid and morphine. If, however, the latter drug is believed to have been taken, the tests are for morphine alone.

The contents of the stomach should be examined for particles of undissolved opium. The odor of opium or its preparations may be detected in the stomach or vomited matters. If the matters found in the stomach be solid, they should be finely comminuted, digested over a water-bath, acidulated with acetic acid, and filtered. The filtrate is then evaporated, and three volumes of strong alcohol added, and well mixed. Filtration is again resorted to, in order to separate the insoluble material, and the filtrate evaporated; this expels the alcohol. The residue should then be dissolved in acidulated water and strained. To the fluid which has passed through, a slight excess of acetate of lead is added until all precipitation ceases. The precipitate produced containing any meconic acid that may be in the solution

is in the form of the insoluble lead meconate. After standing, it is thrown on a filter and the precipitate flushed with pure water. The morphine remains in the solution as an acetate. Therefore there are two portions to be subjected to analysis,—viz., the substance on the filter for meconic acid, and the filtrate for morphine.

I. To separate the *meconic acid*, the material on the filter is diffused through pure water, and sulphuretted hydrogen gas passed for a time; this throws down the black insoluble sulphide of lead, the meconic acid remaining in solution. The mixture is then filtered to concentration, and a trial test made with a portion of this liquid. This is accomplished by treating it with ferric chloride. The remaining part of the fluid is subjected to the lead acetate test. If the characteristic reactions follow, then meconic acid is present, and if in sufficient amount will crystallize on evaporation of the liquid.

II. In the search for the *morphine*, the filtered fluid, containing the morphine in the form of acetate, together with the excess of lead acetate, is to be treated with sulphuretted hydrogen, which is passed through the fluid to saturation, in order to remove the excess of lead acetate by converting the lead into the insoluble sulphide. The mixture should stand in a warm place for several hours, in order that the sulphide may settle, when it may be separated by filtration. The latter is evaporated by gentle heat and placed in a test-tube. To this is added a slight excess of ammonia, a double volume of hot amylic alcohol poured in, and the whole violently shaken. After a little while the amylic alcohol will rise to the top of the tube, and may be removed by means of a pipette. The aqueous fluid should be shaken again with the alcohol, when separation will occur. This may be added to the first portion, and the combined amylic alcohol evaporated at a gentle heat. The residue is then carefully examined for morphine under the microscope. All impurities and extraneous matter should be freed from the residue before applying the characteristic tests for the alkaloid. This is accomplished by dissolving the residue in a little dilute acetic acid and filtering the mixture. The remaining liquid should be alkalized by pure potassium carbonate, and shaken up with a double volume of hot amylic alcohol. This takes up the impurities, leaving the morphine unaffected. The material is then subjected to one of the tests before described.[1]

Detection in the Tissues.—As a rule, the detection of morphine in the organs and tissues is a very difficult if not an impossible task. On the other hand, cases are recorded where it has been detected months after death.

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[1] Dr. Walter S. Haines (Hamilton's System of Legal Medicine) says, "None of the tests for the alkaloid (morphine) are absolutely conclusive when acting upon unknown complex mixtures. Professor Vaughan has clearly shown that under certain conditions normal constituents of the gastro-intestinal tract may give reactions strikingly similar to those produced by morphine when not thoroughly purified. . . . I should be unwilling to accept the presence of morphine as having been demonstrated, unless the alkaloid had been isolated in a pure or practically pure crystalline form, and has given with all the tests unequivocal reactions."

Subdivisions of the organ to be examined, such as the liver, brain, etc., are made. These are treated with water until a thin paste results, when they are subjected to a gentle heat for three hours after having been strongly acidulated. The mixture is then strained, and the fluid which has passed through evaporated to a small bulk. Three or four times its volume of strong alcohol is added, being stirred in. The liquid is then filtered from the resultant insoluble precipitate, and concentrated on the water-bath until complete expulsion of the alcohol has taken place. The remaining sirupy residue should then be extracted with water and filtered. The filtrate is treated with ammonia and hot amylic alcohol, the alcohol evaporated on a watch-glass and tested.

Action of the Poison on Frogs.—Opium or morphine produces a peculiar action on these animals. When the drug is injected, the frog jumps about restlessly, and soon passes into a condition strikingly similar to that occasioned by strychnine when that substance has been employed in experimentation. Tetanic convulsions are readily produced upon the slightest movement on the part of the animal, or by the application of external irritants. This condition is by no means constant. Paralysis of the reflex movements and cessation of respiration follow the tetanic stage, the action of the heart being unimpaired.

Failure to detect the Poison.—It frequently happens, notwithstanding the careful details followed in ascertaining the presence of opium or its alkaloid in complex mixtures, that the minutest trace of the poison is undiscoverable. This result may be due to one of several causes. The poison may undergo some decomposition in the body even before death, thus interfering with the chemical analysis; or life has been prolonged for a number of hours, thus affording an opportunity for its complete absorption from the stomach, rendering it impossible to discover it in any one of the tissues. Again, the presence of ptomaïnes might entirely obscure the poisonous substance.[1] In the famous Dr. Buchanan poisoning case, where the accused was finally convicted of murder in the first degree and electrocuted, the medical experts for the defence claimed that the victim died a natural death, and that the substances found in the body forty-five days after life departed, and which responded to several well-known tests for morphine, were really products of decomposition.

W. S. Haines reports a case where he failed to find the minutest trace of morphine in the stomach of a woman who lived about eighteen hours after swallowing not less than ten or fifteen grains of the drug. The examination was conducted soon after death, but the most careful tests failed to produce the faintest reaction.

It is important to remember, in instances of supposed poisoning, that opium and morphine are used as remedial agents; hence the mere detection

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[1] *Vide* Ptomaïnes.

of morphine or meconic acid in a dead body would by no means demonstrate the existence of poisoning.

ALCOHOL.

Alcohol (*ethyl hydrate*) results from the fermentation of substances containing grape-sugar. It is a light, colorless liquid of burning taste and characteristic smell, uniting in all proportions with water. It is an inflammable liquid. The alcohol of the United States Pharmacopœia has a specific gravity of 0.820, containing ninety-four per cent. of absolute alcohol by volume.

When first distilled, alcohol contains fusel oil (amylic alcohol), glycerin, and succinic acid. Alcoholics are used medicinally as diffusible stimulants, particularly for the action on the heart. Spirituous liquors in large quantities frequently cause death. The administration of this liquid for suicidal or homicidal purposes is rare. The most common cause of fatal cases is observed in those instances where large doses of spirits are ingested, either as a foolish wager, as a silly bravado, or where a person, already in an intoxicated state, is drugged by his companions in a spirit of fun.

The official preparations, together with their strength in alcohol, are subjoined :

Alcohol (*alcohol*) contains ninety-four per cent. by volume of absolute alcohol.

Alcohol dilutum (*diluted alcohol*) contains fifty per cent. of alcohol ; specific gravity 0.920.

Spiritus frumenti (*whiskey*) is obtained by distillation from grain, and is at least two years of age ; it contains from fifty to fifty-eight per cent. by volume of alcohol ; its specific gravity is from 0.917 to 0.930.

Spiritus vini gallici (*brandy*) must be at least four years old. It is obtained from distilling fermented grapes, and contains from forty-six to fifty-five per cent. by volume of alcohol ; its specific gravity is from 0.925 to 0.941. Brandy contains tannic acid, and is therefore better to use in bowel complaints than whiskey.

Vinum rubrum (*red wine*) is obtained by fermenting the juice of colored grapes in the presence of their skins. It contains from ten to twelve per cent. of absolute alcohol, and is somewhat astringent.

Vinum album (*white wine*) is made by fermenting the juice of the grape, and contains from ten to twelve per cent. by weight of absolute alcohol.

Vinum album fortior (*stronger white wine*) contains from twenty to twenty-five per cent. by weight of absolute alcohol.

Many other preparations are employed as beverages, such as *gin* (forty to fifty per cent. alcohol), *weiss beer* (one per cent. alcohol), *cider* (about six per cent. alcohol), and *rum* (about forty to fifty per cent. alcohol). The *sweet wines* contain undecomposed sugar, while the *dry wines* have their sugar converted into alcohol.

Alcohol acts as an *acute* poison by the nerve-action being paralyzed until the progressive influence reaches the medulla oblongata, when coma follows. In cases of *chronic* poisoning the connective tissue is thickened by its influence, thus setting up catarrhal conditions of the mucous membranes an

atrophy of the various glands and organs. The blood-vessels are in a brittle condition; there are tremor and dulness, terminating in paraplegia.

Whiskey owes its injurious effects to the presence of fusel oil (amylic alcohol, potato spirit). This oil has an agreeable smell when in small quantities, but it is suffocating when strong, and produces intoxication, with its sequelæ, with great rapidity.

Symptoms.—*Acute.*—These usually come on rapidly. Large quantities cause disordered digestion, intoxication with muscular incoördination and weakness, and hallucinations. The temperature is lowered, and the patient soon passes into the stage of complete stupor and coma. Collapse soon sets in, unless there is vomiting. The pupils are usually, but not invariably, dilated. The patient's features have a ghastly expression, or they may appear bloated. The lips are livid, the conjunctivæ red, and the odor of alcohol may be detected in the breath. There may appear a bloody froth on the lips; involuntary evacuations may take place; the respiration may be stertorous, increasing in difficulty until, finally, the sufferer dies. This may occur in half an hour, or even sooner, after the ingestion of the fatal beverage. In some cases a remission of the symptoms has taken place, the patient even performing one or more rational acts, etc., apparently recovering from the effects, when suddenly he becomes insensible, and expires during convulsions.

Treatment.—Evacuate the contents of the stomach, and administer strychnine or ammonia. The hot and cold douche, a free supply of fresh air, and galvanism may be tried if there be asphyxia. The administration of coffee as a drink is recommended.

Diagnosis.—Acute alcoholism may be confounded with concussion of the brain and opium-poisoning. In the former affection there may be bruises or injuries of the head, bleeding from the nose and ears, etc. In drunkenness the odor of alcohol is apparent at once, being sufficient to disclose the nature of the case. The dilated condition of the pupils in alcoholism is not a constant sign, since it is not invariably present. Another important point to remember is that the patient may generally be roused for a short period.

Post-Mortem Appearances.—The body, as a general thing, is remarkably well preserved. The stomach presents marks of deep congestion, and the odor of alcohol is readily perceived. There is more or less congestion of the brain, cerebral vessels, and membranes. The lungs are in a state of congestion, and the blood is fluid. Rigor mortis is rather persistent.

Tests.—The odor of alcohol is a valuable sign. Anstie's test consists in adding to the suspected liquid a little potassium bichromate and some sulphuric acid, when, on warming the mixture, an emerald-green color will be produced if alcohol is present. This test depends upon the formation of chromic acid, which by the oxidation of the alcohol is reduced to the emerald-green chromium oxide. Other tests are the taste of the alcohol, which is hot and pungent; its power of burning with a pale-blue flame, leaving no

carbonaceous residue, but producing carbonic acid and water. Alcohol dissolves camphor.

Toxicological Examination.—In some cases the recovery of the alcohol from the stomach can be accomplished by distillation. If the contents of the stomach are acid, they should be neutralized with potassium or sodium carbonate. The mixture is then mixed with calcium chloride and again subjected to the process of distillation. This latter distillate is shaken with dry potassium carbonate. After standing a short time, the stratum of alcohol which appears at the top of the fluid is drawn off for testing purposes.

If alcohol has not been detected in the contents of the stomach, it should be looked for in the liver and brain.

CHAPTER XI.

(2) *ANÆSTHETICS.*

ETHER.

THIS substance, when pure, is a limpid, colorless, mobile liquid, of a peculiar ethereal odor, and hot, pungent taste. It is highly volatile and inflammable, and, when mixed with air, explosive. Ether has a specific gravity of 0.723, while it boils at 34.5° C. It is sparingly soluble in water.

Symptoms.—Its effects, after the administration of large doses, are very similar to those of alcohol. When inhaled it causes slow and stertorous breathing, the surface of the body becomes cold, the face pale, and the lips livid. The period of delirious excitement is soon followed by coma and other symptoms of narcotism. Sensation is entirely abolished. There may be nausea and vomiting.

Treatment.—The stomach-pump should be employed when the liquid has been taken, and followed by emetics; otherwise the treatment consists in exposing the patient to the fresh air, the application of cold affusions, artificial respiration, the galvanic current, etc.

Post-Mortem Appearances.—Ether is a powerful local irritant, and the stomach may be found in an inflamed condition. Congestion of the brain and lungs is usually present. The cavities of the heart are filled with dark liquid blood. The odor of the anæsthetic is perceptible if the autopsy is performed immediately after death.

Tests.—Ether is discernible by its odor and taste and by its volatility. It burns with a smoky flame, depositing carbon, and it strikes a green color, evolving aldehyde when bichromate of potassium and diluted sulphuric acid are added.

The method for its extraction from the stomach is the same as that described for alcohol.

CHLOROFORM.

Chloroform is a colorless, volatile, heavy liquid, evolving a dense vapor. It has an agreeable smell and a pungent taste. Its specific gravity is 1.497, and it is non-inflammable. Chloroform is almost insoluble in water, in which it sinks. At a red heat its vapor is decomposed into chlorine and hydrochloric acid; its solvent powers are great. Two varieties are found in the market, the *chloroformum venale* and the *chloroformum purificatum*, the latter being used for anæsthesia.

Chloroform, like ether and other anæsthetics, when introduced into the system by inhalation, may cause death.

Symptoms.—Locally, chloroform acts as a rubefacient, as a vesicant if confined, and as an anæsthetic to a slight extent. When taken internally it causes inflammation of the stomach.

The symptoms produced by its inhalation may be divided into three sets, of varying intensity. These are: First, stimulation is not so well marked as in the case of ether inhalation. The patient experiences a certain degree of relief from pain, and the various senses are little affected. In the second stage the struggles of the patient are, as a rule, not violent, though in some cases the attempt to struggle is made. The pulse is strengthened and quickened; but during the third stage, or period of anæsthesia, when muscular relaxation and the abolition of sensation and consciousness take place, it is somewhat diminished in frequency, being more or less weak. The breathing is stertorous, and the reflexes are entirely abolished. The patient usually dies from cardiac paralysis.

When chloroform is taken internally in large amounts it acts as an irritant, causing gastro-enteritis, producing anæsthesia after its absorption. Elimination takes place through the lungs and kidneys.

One drachm of chloroform has caused fatal results in a boy aged four years, who died in about three hours after its ingestion. Half an ounce and upward has caused death.

Treatment.—When dangerous symptoms occur, the inhalations should be stopped and the patient inverted. Atropine hypodermatically is recommended; also artificial respiration and faradization. Ammonia and whiskey are indicated if heart-failure ensues. If it has been given internally, the case is to be treated as one of irritant or narcotic poisoning.

Post-Mortem Appearances.—In some cases the appearances of death by asphyxia are apparent. The odor of the anæsthetic is often perceptible. Putrefaction of the body is retarded to a certain extent, and rigor mortis is persistent. In death from inhalation there are no characteristic lesions. The lungs and bronchial tubes may be congested, and likewise the vessels of the brain. The condition of the blood is dark and fluid, and the heart is frequently flabby and collapsed. The writer has seen cases where death resulted from cardiac paralysis from the inhalation of chloroform preparatory to operations, and where no cardiac disease was present.

Tests.—Characteristic tests are the odor and the taste. Chloroform burns with a green flame. When the chloroformum purificatum is shaken with equal volumes of sulphuric acid, a slightly yellow color is produced. It dissolves camphor, caoutchouc, and gutta-percha, and is a powerful solvent of many organic substances, such as the alkaloids, etc.

Toxicological Examination.—The suspected substances are divided, and, together with distilled water, should be put into a large flask, through the neck of which is passed a hard glass tube, bent at right angles. The flask is slowly heated on a water-bath, while the horizontal portion of the tube passes over the flame of a Bunsen burner. The heat decomposes the chloroform, as it passes along the tube, into chlorine, hydrochloric acid, and carbon. If a piece of moistened litmus-paper is placed over the mouth of the tube, it is reddened and bleached. Starch-paper dipped in iodide of potassium is changed to blue, the iodine being liberated and forming the blue iodide of starch. The carbon may be known by its black deposition.

The white chloride of silver is thrown down if the extremity of the tube is placed in a solution of nitrate of silver.

It is important to remember, in connection with this subject, that during profound sleep a person may be anæsthetized without being awakened. If the sleep be slight or partial, the result is negative. (*Vide* Holmes case.)

HYDRATE OF CHLORAL.

Chloral with water forms chloral hydrate. It is a white, crystalline solid, boiling at 98° C. and fusing at 57° C. Chloral hydrate has a disagreeable, pungent taste and an ethereal odor. It is obtained by passing chlorine through absolute alcohol. In water it is tolerably soluble, and with the alkaline hydrates it forms alkaline formates and chloroform. It is non-inflammable.

Symptoms.—In large doses, chloral hydrate acts on the brain as an hypnotic, producing a powerful depressant action on the ganglia at the base of the brain and on the spinal cord. The sleep may pass into coma. Respiration is slowed, and, by the depressing action of the drug on the heart, cardiac failure ensues. The temperature falls, and sensibility and reflex action are depressed. Its irritant action on the mucous membrane may occasion nausea and vomiting. In some cases delirium may supervene and take the place of the sleep which it generally causes.

Toxic doses produce profound narcosis, slow and weak pulse, diminished frequency of respiration, great muscular relaxation, great reduction of the temperature of the body, and a decided contraction of the pupils. The surface of the body is usually livid. Death may be due to heart-failure, occasioned by paralysis of its motor ganglia, or by paralysis of the respiratory function.

Chloral hydrate appears to be a cumulative poison; so care must be exercised in its administration. Frequency in repetition of the medicine is to be discountenanced.

The action of this drug is supposed by some to be due to its decomposition in the blood, whereby an alkaline formate and chloroform are produced.

The smallest recorded *fatal dose* is thirty grains, while, on the other hand, enormous quantities (more than one ounce) have been swallowed with impunity.

Treatment.—The temperature of the body should be kept up by artificial heat. Small and repeated doses of atropine are indicated to maintain the action of the heart. Respiration is to be maintained by atropine or morphine, or by artificial means. Picrotoxin has been used as an antidote.

Post-Mortem Appearances.—The odor of the drug may be noticed after death. The lesions of chloral-hydrate-poisoning are not characteristic. Hyperæmia of the brain may be observed in some cases.

Extraction from the Stomach.—The solid, suspected materials should be divided and diluted with distilled water. They are then treated with potash to render them alkaline, heated in a flask, and tested for as previously described under the head of Chloroform.

NITROUS OXIDE.

This is a colorless, almost odorless, gas, produced by the action of heat on ammonium nitrate. It is frequently employed as an anæsthetic in minor surgical operations, as the extraction of teeth, etc. The anæsthesia produced is very likely due to a diminution of the relative amount of oxygen in the blood. When death results, it is usually due to asphyxia.

METHYLENE BICHLORIDE. ETHYL BROMIDE.

The first of these anæsthetics is a colorless, neutral liquid, with an odor similar to that of chloroform. Its vapor is highly inflammable, and when inhaled produces unconsciousness and freedom from pain. These effects soon disappear when the inhalation is discontinued. Fatal results are due to paralysis of the heart.

Ethyl bromide is a colorless, neutral liquid, with a sweetish, disagreeable taste and ethereal odor. When inhaled it acts on the heart similarly to chloroform, being equally as dangerous. It is anæsthetic in its effects, but is seldom used as such.

CHAPTER XII.

ORDER II.—SPINAL NEUROTICS.

NUX VOMICA AND STRYCHNINE.

Nux Vomica—Strychnine—Symptoms—Treatment—Fatal Dose—Fatal Period—Post-Mortem Appearances—Diagnosis—Chemical Tests—Detection of the Poison in the Stomach—Detection in the Tissues—Quantitative Determination—Physiological Test—Discovery of the Poison after Long Periods—Failure to detect the Poison—Elimination—Brucine.

Nux vomica is the seeds of Strychnos nux vomica, or poison nut (nat. ord. *Loganiaceæ*), a tree growing in India. The seeds contain two active principles, *strychnine* and *brucine*, combined with lactic and igasuric acids. These latter exist in the proportion of from five-tenths per cent. to upward of one and five-tenths per cent. Some authorities claim a third alkaloid, *igasurine*. Nux vomica is the most important poison of the neurotics. The preparations employed medicinally in the treatment of disease are as follows :

Abstractum nucis vomicæ (*abstract of nux vomica*). Dose, gr. ss to ii.
Extractum nucis vomicæ (*extract of nux vomica*). Dose, gr. $\frac{1}{4}$ to i.
Extractum nucis vomicæ fluidum (*fluid extract of nux vomica*). Dose, ♏ii to v.
Tinctura nucis vomicæ (*tincture of nux vomica*). Dose, ♏i to xx.
Strychnina (*strychnine*).
Strychninæ sulphas (*sulphate of strychnine*). Dose, internally, gr. $\frac{1}{30}$ to $\frac{1}{10}$; hypodermatically, gr. $\frac{1}{60}$, cautiously increased.

Strychnine is frequently employed as a homicidal or suicidal agent. It appears in commerce as a white powder, or in the form of larger crystals, which are usually octahedra and four-sided prisms. It is odorless and very sparingly soluble in water (8333 parts of cold water are required). Absolute alcohol dissolves one part in about two hundred at ordinary temperatures, whiskey one part in about four hundred, and so with other similar liquids. Fourteen hundred parts of ether are necessary to dissolve one part of strychnine, chloroform one part in eight, and commercial ether one in about one thousand parts. Equal volumes of ether and chloroform dissolve it readily. It is insoluble in the fixed alkalies and sparingly so in ammonia. Strychnine is also found in other species of strychnos and in the seeds of Strychnos ignatii.

The taste of this alkaloid is intensely bitter, and may be recognizable when so dilute as 1 in 100,000.

The principal salt of strychnine is *strychnine sulphate* (StH_2SO_4), which dissolves in ten parts of water and sixty parts of alcohol. An important

int in connection with the properties of this alkaloid is that it does not ar or color with sulphuric acid, as do most other organic compounds.

Symptoms.—As the symptoms of nux vomica and strychnine are sentially the same, they will be considered together. Strychnine acts ore rapidly than the former, but that is the only difference between the two.

The form in which the drug is given regulates to a certain extent the eriod of commencement. The first effect of the poison is a sudden shuddering, restlessness, and great uneasiness, with a sense of impending danger. This is quickly succeeded by tetanic convulsions of all the voluntary muscles, accompanied with muscular pains, which pervade the whole body. The legs are stretched out stiffly, the feet are in an arched condition, and he arms drawn tightly round the chest. The head is bent back rigidly, and he body rests upon the head and heels, *opisthotonos*. The face presents a ghastly grin, the *risus sardonicus*, and soon becomes livid from the embarrassed respiration. The muscles of respiration are rigidly contracted, producing a sensation of suffocation; these muscles and the diaphragm remain fixed. The pupils are contracted, but dilate again with the relaxation of the spasm. The jaws are not always *set* during a paroxysm, and hence the patient may be able to speak. The pulse is usually very rapid and feeble. The mind is clear, even during the most intense suffering; gasping for breath, the patient seeks in vain for relief.

The paroxysm generally lasts from a quarter of a minute to a minute, though in some instances it may last from half a minute to several. After a time the muscles relax and an interval of quiet occurs; the patient is exhausted and bathed in perspiration; the pupils may be in a state of contraction or dilatation. After a short period of rest, varying from a few minutes to half an hour, the convulsions return, succeeding one another with remarkable rapidity. In fatal cases the spasms increase in frequency and violence, and the patient may die of asphyxia from fixation of the respiratory muscles, or death may follow paralysis or collapse during one of the intervals.

The mind is usually clear to the last, though it may become clouded just before death, as a result of the deficient aëration of the blood.

The symptoms of poisoning may be masked somewhat when the drug is associated with other substances, such as opium, chloral, and other narcotics.

Treatment.—Prompt and free emesis is to be carried out; but if emetics fail, the stomach-pump should be passed through a perforated gag, to prevent the patient from biting it during a convulsion. Through this strong infusions of tea or oak bark or solutions of tannin should be injected, and the stomach thoroughly washed out. Before resorting to this method, the usual antidotes, such as chloral, chloroform, and the bromides, may be administered. If the sufferer cannot take them on account of the spasms, he should be put under the partial influence of an anæsthetic, such as chloroform, when they can be given. The chloral may be given by the rectum, thirty to sixty grains, as necessary. While the latter drug is a good antidote for strychnine-poisoning, the converse does not hold good. Paralde-

hyde and urethane have been recommended as antagonistic to this poison. The latter drug is administered in doses of from four to six grains. Atropine has proved efficacious where chloroform failed, and where the spasms were severe. Nitrite of amyl is another efficient remedy.

Fatal Dose.—One-sixth of a grain has caused death ; also one-quarter of a grain. In the celebrated case of Dr. Warner, one-half of a grain, taken by mistake, occasioned death in eighteen minutes. A fatal dose for an adult may vary from half a grain to a grain. On the other hand, recovery has occurred after large doses, even after the ingestion of fifteen to forty grains.

One-sixteenth of a grain proved fatal to a child of two years. Reese mentions the case of a man who suffered intense spasms after taking about one-twentieth of a grain. Infants at the breast may show poisonous symptoms occasioned by the mother's milk, though the latter remains unaffected. This is probably due to the more irritable nature of the spinal cord of children. One-sixteenth of a grain hypodermatically has produced alarming symptoms.

Fatal Period.—As a rule, death or recovery is always speedy, and the hope for recovery may be entertained if the patient lives over five or six hours. In Dr. Warner's case, before referred to, death occurred in eighteen minutes, and instances are recorded where the poison caused fatal results in five minutes. Again, life has been prolonged for several hours. Reese mentions a case where a woman died six hours after taking six grains of the alkaloid. In this instance, however, morphine had been previously given. Death has followed a dose of nux vomica in fifteen minutes after swallowing. (Christison.)

Post-Mortem Appearances.—These are not characteristic, nor are they always similar. There may be congestion of the brain and spinal cord, with considerable effusion of blood. The stomach is usually normal, but occasionally it is found to be in a state of intense congestion ; also the lungs. The heart is sometimes full and distended, but more frequently these signs are absent. The body is usually relaxed at the time of death, but it rapidly takes on extreme rigidity, which is generally very marked and lasting.

As mentioned above, the appearances after death are not entirely characteristic ; but other affections rarely produce collectively the congestion of the brain and cord, the effusion of blood and serum, and the rigor mortis.

Diagnosis.—The effects of strychnine-poisoning are usually so characteristic that there is no great difficulty in forming a clear diagnosis from the symptoms alone. The only affection that can be confounded with it is tetanus, and possibly some forms of epilepsy. As a general thing, there is a great difference between the tetanus occasioned by a wound, or from disease, and that produced by strychnine. Diseases that have been advanced, on various medico-legal occasions, as bearing a resemblance to strychnine-poisoning are chorea, puerperal and uræmic convulsions, epilepsy and syphilis.

The symptoms occasioned by *tetanus* differ from those of strychnine-poisoning in the following respects: There is usually a history of some exciting cause, such as an injury, etc. The symptoms come on gradually, and reach their maximum development only at the end of several hours, progressing slowly toward a fatal termination. As a general thing, several days elapse between the commencement of the trouble and death. The muscles that are first attacked are generally those of the back of the neck, and those of the jaw are early affected. The rigidity is more or less permanent, there being no intervals of relaxation, as in the case of strychnine-poisoning. The temperature is generally above the normal.

In *strychnine-poisoning* there is no history of an injury, and the symptoms appear suddenly, without warning, and progress rapidly to a fatal termination. The muscles of the extremities are affected before any of the other voluntary muscles, those of the neck and jaw being affected last. The entire muscular system may be thrown into a convulsion almost simultaneously. During the intervals between the spasms there is mostly complete relaxation, and the opisthotonos passes away. The body-heat is usually normal. There are some exceptions to these differences, but, as a rule, the diagnosis between the two affections is clear.

As regards *epilepsy*, the mode of invasion, the unconsciousness, the clonic spasms, etc., are entirely at variance with the characteristic signs of strychnine-poisoning. So, too, the profound stupor which ends the epileptic attack is markedly contrasted with the perfect consciousness and complete relaxation that succeed the strychnine convulsion.

Tests.—Strychnine may be recognized by its intensely bitter taste, and can be readily detected 1 in 50,000, and 1 in 10,000 is distinctly bitter. The taste is even more delicate than the color test. It is well to remember, however, that salicin, quinine, morphine, and other substances are also bitter, though none possesses the intensity of the bitterness of strychnine. Taste, therefore, is a highly characteristic test for this alkaloid.

Haines[1] mentions four instances where persons were unable to appreciate the bitterness of strychnine. They described the taste as rough and slightly musty. Again, the bitterness may be *covered* by such substances as tannic acid, licorice, and chocolate. More or less bitterness is to be expected in examining a suspected residue if strychnine be present. If it is not bitter, it is not strychnine, but, though bitter, it may be something else.

The Color Test.—If strychnine is dissolved in sulphuric acid, no change occurs; but if an oxidizing agent, such as manganese dioxide, lead peroxide, potassium bichromate, etc., be added, it gives rise to a play of colors from deep blue to purple, violet, rapidly changing to crimson or red, and orange-yellow. Other substances, when treated with sulphuric acid and an oxidizing agent, occasion a play of colors similar to those mentioned. Such substances are quebrachine, aniline, cod-liver oil, papaverine, curarine, and

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[1] Hamilton's System of Legal Medicine.

veratrine. The colors produced by these agents are sometimes due to the sulphuric acid alone, or they do not present the same sequence as those occasioned by strychnine. Quebrachine is the only alkaloid substance which might be mistaken for strychnine when the color test is applied, as it produces the same colors in the same order as does strychnine. It is possible, however, to discern a slight difference in the intensity and duration of the play of colors. Again, quebrachine is dissipated by heating it on a water-bath, while the alkaloid of nux vomica remains unaffected. Aspidospermine may also give a strychnine-like reaction, as it contains quebrachine.

The medico-legal importance of the color test does not consist merely in the production of the blue color, for this might be occasioned by the application of potassium permanganate to other organic bodies in the absence of strychnine; but its chief value lies in the regular succession of colors. The one-millionth of a grain of strychnine can be detected by this test if the drug be perfectly pure.

There are other substances, such as brucine, morphine, and the nitrates, which might considerably modify this test by their presence. Accordingly, they must be separated, else the true value of the reaction is lost. The most important of these modifying substances is morphine; and it can be readily isolated by heating the mixture with strong sulphuric acid, when the strychnine will be easily recognized.

The color test may be further interfered with by the presence of certain indefinite organic substances extracted from the organs to be examined. Therefore, the material should be carefully purified; which done, the reaction becomes perfect. Ptomaïnes may produce a strychnine reaction, but their other properties are so entirely different from strychnine that the two should not be confounded; besides, they are destroyed by heating with sulphuric acid.

The Chromate Test.—If a solution of strychnine is treated with potassium bichromate, a bright-yellow precipitate of strychnine chromate is produced. It soon becomes crystalline, and under the microscope appears as octahedral plates. If dried and touched with a drop of strong sulphuric acid, a play of colors is formed which is similar to that occasioned by the color test. This is a very *true* test.

The Galvanic Test.—Dr. Letheby suggested the use of galvanism in the production of the play of colors (color test), the principle being the same, with the exception that the nascent oxygen is evolved by means of the battery. A drop of a solution of strychnine (1 part in 15,000 or 20,000 parts of water) is placed in a small cup-shaped depression on the platinum-foil, and allowed to evaporate, when the spot is moistened with strong sulphuric acid. The foil is then connected with the positive pole of one cell of Grove's battery; the acid is touched with a platinum terminal from the negative pole, with the result that the violet color will flash out, and remain after the negative pole is removed.

The Chlorine Test.—If a slow stream of chlorine gas is diffused through

dilute solution of strychnine, each bubble of the gas will be enveloped in a white film, and a white, amorphous deposit, soluble in ammonia, takes place. According to Tardieu, no other alkaloid produces the same effects.

The Carbazotic Test.—Strychnine is thrown down in solution by carbazotic or picric acid, an abundance of yellowish crystals being the result. The reaction is best viewed under the microscope; and, for this purpose, the strychnine solution is placed on a glass slide, to which a drop of the carbazotic acid solution is added.

Detection of the Poison in the Stomach.—The stomach and its contents should be finely comminuted, and a sufficient quantity of pure, acidulated water added in order to make the mixture distinctly fluid. The mixture is digested on a water-bath for about an hour, and then strained while still hot. After the liquid has been evaporated to about one-quarter its former volume, strong alcohol is slowly stirred in to separate the insoluble material, which should be removed by filtration. The filtrate is then evaporated to a thick sirup, and, after cooling, is taken up with a small amount of water acidulated with acetic acid. The mixture is again filtered into a test-tube and liquor potassæ added, also an equal bulk of chloroform, when the whole is shaken. When the chloroform has settled, the aqueous fluid is removed, and the same process repeated with another volume of chloroform. The two chloroform solutions are united, and concentrated by evaporation, when the residue will be found to contain any strychnine that may be present, mixed with organic matter. This residue should next be freed from the impurities by thoroughly mixing it with diluted acetic acid. It is then filtered, rendering it alkaline, and agitated with chloroform for some minutes. If this is evaporated, the alkaloid will be deposited in an almost pure crystalline condition. For still further purification, which is absolutely necessary in medico-legal cases, two or three drops of strong sulphuric acid should be added to the residue, and subjected to the heat of the water-bath for several hours, when the impurities will be carbonized or chemically altered. The mixture is then diluted with a small quantity of water, filtered, alkalized, and briskly shaken with chloroform. The chloroform is allowed to separate by evaporation on a watch-crystal, the residue being left in a pure condition. The various tests are now in order. After dissolving the residue in acetic acid, the *taste test* may be applied, or a drop of this solution evaporated and submitted to the *color test*, or another drop treated with the *chromate test*, and subsequently examined by the microscope. Again, some of the suspected liquid may be injected subcutaneously into a small, delicate frog, and the effects noted. (*Vide* Physiological Test.)

Detection in the Tissues.—Strychnine, after absorption, is deposited in the various organs like mineral poisons. Its absorption may occur with considerable rapidity, and the detection of the poison be accomplished soon after death. Strychnine is usually found in the liver and kidneys, but it has been discovered in the blood, spleen, brain, and heart,—in fact, in almost all parts of the body. It is best to examine the body immediately after death.

The tissues should be finely subdivided and digested in alcohol acidulated with sulphuric acid. When cool, the mixture is subjected to filtration and concentration, the residue being flushed with alcohol previously acidulated. Evaporation is then resorted to, and the residue treated, as above described, with chloroform. The latter is evaporated, the residue purified, and the tests applied as before.

Quantitative Determination.—The qualitative process, as described previously, is carried on to the point where the chloroform (after the impurities are carbonized or otherwise altered) is evaporated on a watch-crystal. Further purification is accomplished by treating the residue with a few drops of cold water, when it is dried and subjected to the action of strong sulphuric acid, and again dissolved out with chloroform, the latter being evaporated, and the process just described repeated in order to insure the perfect purity of the alkaloid, which is necessary for the weighing. The residue, when cool, is then weighed.

Physiological Test.—Dr. Marshall Hall was the first one to employ this test, and it consequently bears his name. If a small frog be immersed in a solution of strychnine, or a subcutaneous injection of the fluid be made, strong tetanic convulsions will follow and reappear every time the animal is subjected to irritation. If the dose administered be a large one, death ensues. The one-ten-thousandth of a grain may be recognized by this test.

Discovery of the Poison after Long Periods.—Strychnine may be discovered in a body some time after death, and it probably owes this property to its power of resisting decomposition. Cases are recorded where the poison has been detected even after the lapse of years, and Richter extracted it from putrid tissues eleven years after death.

Most authorities agree, however, that the alkaloid slowly disappears after the interment of the body underground, until, finally, it cannot be recognized.

Failure to detect the Poison.—Failure to discover strychnine after death, even where the conditions are favorable, may be due to the smallness of the dose, imperfect methods of extraction, incompetent manipulation of the analysis, or to the interference of some ptomaïne, especially where decomposition is far advanced.

Elimination.—The kidneys are the chief channels for the elimination of strychnine, and its presence in the urine is readily detected, though it usually disappears after the second day. It is generally understood that the poison is eliminated from the entire system within forty-eight hours.

BRUCINE.

This substance is generally found associated with strychnine, but its poisonous action is feebler, possessing from one-seventh to one-thirty-eighth of its powers.

Brucine is soluble in chloroform and alcohol, being more so in the latter fluid and water than is strychnine. If taken in sufficient quantity, the symptoms are identical with those caused by the latter substance, and the treatment

is the same. Like strychnine, brucine is intensely bitter. It turns to a blood-red color in the presence of nitric acid, and is dissolved by concentrated sulphuric acid, a faint rose coloration resulting.

Brucine occurs in powder form, or in colorless prismatic crystals, and does not respond to the color test of strychnine.

Tests.—Nitric acid produces a blood-red color, which on heating changes to yellow, rapidly dissolving the alkaloid. If, after cooling, a solution of stannous chloride is added, a beautiful purple color is formed. This test distinguishes brucine from all other alkaloids. Nitric acid strikes a somewhat similar red color with morphine, etc., but it is not changed by stannous chloride.

Nascent oxygen generated in the color test for strychnine has no action on this poison; but if it is treated with bichromate of potassium, and then sulphuric acid, a play of colors is produced in the following order: orange, green, and, lastly, yellow, being dependent upon the reduction of the chromium salts.

If methyl iodide is added to a strong alcoholic solution of the alkaloid, crystals in the form of circular rosettes appear. This test acts negatively with strychnine.

The physiological test is applicable to brucine. The *toxicological examination* is similar to that described under strychnine; and, in testing, the nitric acid should be first tried and then the stannous chloride.

CHAPTER XIII.

ORDER III.—CEREBRO-SPINAL NEUROTICS.

(1) *DELIRIANTS.*

BELLADONNA AND ATROPINE.

Belladonna is the berries, leaves, and root of Atropa belladonna, or deadly nightshade (nat. ord. *Solanaceæ*), a plant of Europe, but cultivated in the United States of America. Its properties depend upon an alkaloid termed ***atropine***, which exists in all parts of the plant, especially the root, as a malate. It is found to exist in the root in quantities ranging from three-tenths to five-tenths per cent. The parts of the plant mentioned are all violently poisonous, children being often poisoned by eating the berries.

Atropine.—This alkaloid exists as a bitter, colorless, crystalline solid, without any odor, and is possessed of an acid taste. It is somewhat soluble in water, and readily so in chloroform and ether. Its properties are strongly alkaline, so much so that it neutralizes acids and produces salts, most all of which are soluble in water. Its principal salt is atropinæ sulphas, the

medicinal dose of which ranges from one-hundred-and-twentieth to one sixtieth of a grain.

Symptoms.—Atropine, as a rule, acts quicker than belladonna; otherwise the symptoms are identical. The symptoms generally begin in from one and a half to two hours after the ingestion of the drug, but may be protracted for four or five hours. Sometimes they occur within twenty minutes. There are a sense of heat and dryness in the mouth and throat, dysphagia, nausea, and vomiting, together with giddiness, drowsiness, and intense thirst. There are extreme dilatation of the pupil, loss of vision, and the saliva may be suppressed. The vision may be indistinct or double. The action of the heart is increased, the pulse being abnormally rapid and strong. The face is flushed, and the eyes unusually brilliant and prominent. There may be some congestion of the conjunctivæ. An early sign is loss of speech, with constant movement of the tongue and lips, as if attempting to speak. Irritation of the genito-urinary apparatus frequently occurs, and strangury, suppression of the urine, and hæmaturia follow. Often a scarlet eruption of the skin is noticed, and the limbs of the patient may appear numb. Profound coma sets in, and death occurs, frequently preceded by convulsions.

Treatment.—If the case is seen early, the stomach should be thoroughly emptied by the stomach-pump or tube, or stimulant emetics, castor-oil, and animal charcoal administered. Chemical antidotes should also be given, such as tannic acid, a solution of iodine, or morphine. The latter may be administered hypodermatically, in doses of from a quarter of a grain to a grain, and repeated if required, to control the delirium. Diuretics, like sweet spirit of nitre, are often useful, as the poison is largely eliminated by the urine. Pilocarpine has been recommended as a useful remedy, given either by the mouth or subcutaneously. To prevent reabsorption of the poison, the patient should be catheterized.

Fatal Dose and Period.—Fatal results have followed the eating of a few ripe berries; and a clyster of the root, containing one-sixth of a grain of atropine, has caused death. The smallest quantity recorded that has occasioned fatal results was one-thirtieth of a grain of the alkaloid. This was administered subcutaneously. One-twelfth of a grain, given by the mouth, likewise proved fatal. On the other hand, large doses have been recovered from. Dr. Elliot mentions but two deaths out of thirty-two cases.

In some cases death takes place within a couple of hours; one case is reported where the fatal results occurred in five minutes after the hypodermatic injection of a small dose of atropine. Death usually takes place, however, within fifteen or sixteen hours after the poison has been taken.

Post-Mortem Appearances.—These are usually not very characteristic. The main points are the congestion of the cerebral vessels and lungs together with the dilated and brilliant condition of the eyes. There may be redness of the tongue and injection of the mucous membrane of the stomach and small intestines. If the berries have been ingested, the mucous mem

brane of the former organ may assume a purplish hue. Occasionally no post-mortem effects are noticed.

Tests.—(1) *Physiological Test.*—This test consists in introducing a portion of the ultimate extract into the eye of the rabbit, or of man, when marked dilatation of the pupil occurs. The minutest amount of atropine will produce this effect, and the test is very delicate, the one-hundred-thousandth of a grain being detected.

Other substances produce a similar effect, and hyoscyamine and hyoscine are more powerful even than the belladonna alkaloid. Other drugs, like digitalis, cocaine, and coniine, also produce dilatation of the pupil, though to a less degree. Other investigators, notably Selmi, have demonstrated the mydriatic power of certain ptomaïnes.

(2) *Vitali's Test.*—A small portion of atropine is treated with fuming nitric acid, evaporated to dryness on the water-bath, and when the mixture is cold it is touched with a drop of potassa dissolved in absolute alcohol, when a violet color is instantly produced, rapidly changing to dark red, and then vanishing. Less than one-fifty-thousandth of a grain of the alkaloid gives a decided reaction.

Hyoscyamine and hyoscine give the same reaction. Before applying Vitali's test to the suspected material, the latter should be thoroughly purified.

(3) *Wormley's Test.*—If a solution of hydrobromic acid, saturated with free bromine, is added to an atropine solution, a yellow precipitate, which rapidly becomes crystalline, is produced. This precipitate is insoluble in the mineral acids, acetic acid, and the caustic alkalies. This is a characteristic test for atropine, the one-ten-thousandth of a grain producing excellent results. With hyoscyamine and hyoscine it produces similar results. A crystalline precipitate is also formed with this test, though the difference between it and atropine can be observed under the microscope; moreover, meconin does not respond to either the physiological or Vitali's test.

(4) If atropine is heated in a test-tube with a few drops of sulphuric acid and a fragment of potassium bichromate, it gives rise to a green color and an odor of attar of roses or orange-blossoms.

(5) Iodine in iodide of potassium produces a reddish-brown precipitate, which is insoluble in potash or in acetic acid. This reaction is not characteristic, though a very minute portion of the alkaloid produces it.

Toxicological Examination.—The contents of the stomach should be carefully examined for berries, seeds, or remains of the leaves or root, as their discovery affords strong evidence as to the cause of death. Pieces of these substances may also be found in the vomit and stools. The stomach and contents should be finely comminuted and acidified with acetic acid and warm alcohol and filtered. The latter is then treated with subacetate of lead and sulphuretted hydrogen, thus throwing down the sulphide of lead. The clear filtrate is evaporated to dryness, acidified, and saturated with an excess of a solution of potassa. Alcohol is added and the extract tested.

STRAMONIUM.

Stramonium is a very common plant, found in Europe and the United States; other varieties occur in India. It is the leaves and seeds of Datura stramonium (*Jamestown weed or gypsum, thorn apple*) (nat. ord. *Solanaceæ*), and contains an active principle called *daturine*, which is isomeric with the alkaloid of belladonna, producing the same effects. The seeds and fruit are very poisonous, but all parts of the plant are noxious.

Symptoms.—The symptoms are similar to those occasioned by belladonna-poisoning. There are dryness of the throat, dysphagia, dilated and insensible pupil, delirium, headache, vertigo, nausea and vomiting, tinnitus aurium, spectral illusions, etc., succeeded by stupor and coma. Occasionally convulsions and paralysis and the scarlatinal kind of rash are observed. Poisonous symptoms have originated from the external application of the bruised leaves. In India the Datura is frequently employed for the purpose of drugging persons.

The *post-mortem appearances* are very similar to those resulting from belladonna. The *treatment* is the same as for the latter drug.

The method of *extracting* daturine from the stomach and contents is the same as that described for belladonna and atropine.

HYOSCYAMUS.

Hyoscyamus niger, or henbane, is a native of Europe, but is found in America (nat. ord. *Solanaceæ*). All parts of this plant are poisonous, but the seeds are more active than either the root or leaves. It owes its powers to two alkaloids, *hyoscyamine* and *hyoscine*, both of which are isomers of atropine and daturine. Their effects are very similar to those produced by atropine and the latter alkaloid. Hyoscyamine does not dilate the pupil as rapidly as atropine. Hyoscine produces flushing of the face, dryness of the mouth and throat, sleep, retarded respiration, and in large quantities a slow and full pulse. It also causes a rise of the temperature of the body, muscular weakness and incoördination, diaphoresis, and has a less tendency to produce delirium than atropine or hyoscyamine.

There are no characteristic lesions after death, and the treatment is the same as that of belladonna-poisoning.

SOLANUM.

Of this genus there are three species which are decidedly poisonous,—viz., Solanum dulcamara (*bittersweet, woody nightshade*); Solanum nigrum (*garden nightshade*); and Solanum tuberosum (*common potato*). The active principle of these plants is *solanine*.

Solanum dulcamara is largely cultivated in gardens on account of its beautiful purple flowers and red berries. It is, however, a native of Great Britain. The berries are often eaten by children with poisonous results.

Solanum nigrum possesses white flowers and black berries, the latter

being also frequently swallowed by children. The poisonous effects of the berries are more powerful than any of the other plants.

Solanum Tuberosum.—The berries of this plant have caused death, the symptoms being similar to those of belladonna and other mydriatics. The young shoots of the plant are also poisonous in some instances.

The general symptoms of solanine are like those occasioned by the mydriatics, though less powerful.

Solanine exists in the form of acicular crystals, almost insoluble in water. It is soluble in alcohol, amylic alcohol, less so in ether, and insoluble in chloroform. Nitric acid dissolves it, the result being at first a colorless solution, which finally changes to a rose-red tint. Cold sulphuric acid produces an orange-yellow, and, after dissolving, it turns brown.

To separate this alkaloid from organic mixtures, a modification of the Stas process is employed. Alcohol and sulphuric acid are used as solvents, and warm alcohol to separate the final extract.

ERYTHROXYLON AND COCAINE.

Erythroxylon is obtained from the leaves of Erythroxylon coca (nat. ord. *Erythroxylaceæ*), a shrub indigenous to Peru. It contains an alkaloid called *cocaine* combined with cocatannic acid. The amount of the alkaloid found to exist in the fresh leaves varies from three-tenths to one per cent., the average being about three-fourths per cent. The physiological effects of erythroxylon and its alkaloid are similar.

Symptoms.—The symptoms are modified, to a certain extent, by the quantity of cocaine absorbed. There are usually great nervous excitement, oppression and fulness in the head, sometimes attended with nausea and vomiting. At first the respiration and pulse may be increased in frequency, but later on the former may be lessened considerably; the pulse also may be diminished in frequency. The breathing may then be slow and labored, and the face cyanotic, on account of the deficient oxygenation of the blood; the pupils are dilated, and the extremities become cold. In fatal cases the breathing is labored, the pulse feeble, often imperceptible, and convulsions supervene, followed by coma and death; the latter usually occurs from apnœa, or heart-failure. These symptoms are subject to variation. Occasionally there is delirium, or unconsciousness even from the commencement of the trouble, while in other instances the only prominent sign is the asphyxia.

Treatment.—Evacuate the stomach if the poison has been taken by that route; also use emetics, iodine, tannic acid, or animal charcoal. If given by subcutaneous injection, which is usually the case, administer stimulants (alcohol and ammonia). Nitrite of amyl has been successfully employed. The hypodermatic injection of nitro-glycerin may be tried. Inhalations of oxygen are of service in relieving threatened asphyxia. Sometimes electricity or artificial respiration is necessary.

Fatal Dose and Period.—One-half of a grain of cocaine has proved

fatal when taken internally; and one-twentieth of a grain, hypodermatically, caused violent and dangerous symptoms in a girl of twelve years. Poisonous symptoms have been produced by the application of one-hundredth of a grain to the eye of a child fourteen years of age. Recovery has followed the ingestion of twenty-two grains, and ten grains administered subcutaneously.

When applied to mucous membranes or administered subcutaneously, cocaine acts with rapidity. Death has occurred in forty seconds, and in another case in four minutes. Recovery is almost a certainty should the patient survive half an hour.

Post-Mortem Appearances.—These are not very characteristic. There may be congestion of the lungs and other organs, and the blood may be dark and fluid.

Tests.—(1) If a few drops of potassium permanganate are added to a solution of cocaine or any of its salts, violet-colored crystals of cocaine permanganate are thrown down.

(2) If a solution of cocaine is boiled with dilute sulphuric acid for a few minutes, decomposition results with the formation of benzoic acid. If potassium hydrate is now added to the liquid, and also a few drops of a solution of ferric chloride, ferric benzoate is thrown down as a pale, brownish-yellow precipitate.

(3) A peppermint odor is given off if fuming nitric acid is added to cocaine, evaporated to dryness, and the residue treated with an alcoholic solution of caustic potash.

(4) Cocaine is a colorless, crystalline solid, which dissolves in ether and chloroform. It is sparingly soluble in water. The salts are very bitter, but the free alkaloid has only a slightly bitter taste. Cocaine unites with acids and forms salts. The most frequently used salt in medicine is the muriate or hydrochlorate, produced by the union of cocaine with hydrochloric acid.

(5) Marked dilatation of the pupil follows the introduction of the alkaloid into the eye of man or one of the inferior animals. This action differs from that occasioned by atropine in disappearing in a comparatively brief period of time,—a few hours at the most,—and also in requiring for its production a larger quantity of the drug.

Toxicological Examination.—The tissue to be examined should be finely comminuted. Water is then added until a thick paste results, when the mixture is acidified with acetic acid. The contents of the stomach or the vomit should be made fluid by the addition of water, and also acidified, as in the above case. The mixture is next digested for an hour or so, and strained, when the process for the extraction of alkaloids, already described, is followed. After this has been done, a portion of the residue is dissolved in a little dilute acetic acid and touched to the lip or tongue, and the effect noted. The second portion is applied to the eye of a cat or rabbit, and the effects upon the pupil watched for some hours. A third portion should be tested by the several reactions already mentioned. If all these results are negative, no cocaine is present.

CHAPTER XIV.

(1) *DEPRESSANTS.*

TOBACCO AND NICOTINE.

General Remarks — Nicotine — Symptoms — Treatment—Fatal Dose and Period — Post-Mortem Appearances—Resistance of the Alkaloid to Putrefaction—Tests—Toxicological Examination—Tobacco-Smoking.

Tobacco is the dried leaves of Nicotiana tabacum (nat. ord. *Solanaceæ*), a plant which owes its peculiar properties to *nicotine*, an alkaloid which somewhat resembles coniine. Tobacco also contains nicotianin and an empyreumatic oil. Nicotine exists in all parts of the plant, the amount varying in the various specimens, and ranging from two to eight per cent.

Nicotine, when pure, is a colorless oily liquid, of characteristic smell, somewhat heavier than water, and boiling at 250° C. It is soluble in water, alcohol, ether, and chloroform. It has a strong alkaline reaction, neutralizes acids, and produces neutral salts. Nicotine slowly volatilizes at ordinary temperatures, becoming colored, and finally changed into a brown resinous substance. It is very poisonous, and is more rapid in its effects than even prussic acid.

Symptoms.—The symptoms produced by tobacco are the same as those of nicotine, and hence the two drugs will be considered together. Toxic doses produce a violent sense of giddiness, together with nausea and vomiting, great prostration, trembling of the limbs, and often violent purging. The pulse is rapid and feeble, and the respiration difficult. There is great heat in the stomach, the skin is cold and clammy, and in some cases convulsions of a tetanic character occur. The pupils are usually dilated, though the reverse often happens; the face becomes blanched, the lips blue, and the extremities cold. The respiratory function becomes more and more embarrassed; there is a sense of impending danger; coma, preceded by convulsions, occurs, and the patient dies in apnœa. The heart continues to act after cessation of respiration.

The *external* application of tobacco, either to ulcers, etc., or to the sound skin, often produces violent symptoms, and even death. Fatal effects have followed the administration of the infusion of tobacco when used as an enema. A case is recorded where a man suffering from an eruptive disease died in three hours after the application of a decoction to the skin.

Treatment.—This consists in the administration of emetics, to be followed with iodine and pulverized charcoal, to prevent the absorption of the poison. The stomach should be well washed with a strong infusion of tannin, and stimulants given. Electricity is sometimes applied to promote

the respiratory efforts. The oxygenation of the blood may be increased by inhalations of pure oxygen.

Fatal Dose and Period.—The fraction of a grain of the alkaloid may prove fatal. The application of the leaves has occasioned death. Recovery has followed large quantities.

The rapidity of the effects of tobacco and its alkaloid depends upon the size of the dose and the mode of administration. Nicotine acts with remarkable rapidity, death having occurred in one case within three minutes of the administration of the poison. In the case of Count de Bocarmé, who poisoned his brother-in-law, Gustave Fourgnies, and who was afterwards executed, the latter died in five minutes after the poison (nicotine) had been given. In other cases the fatal period has been delayed for several hours, and even until the second day.

Post-Mortem Appearances.—There are no characteristic signs left by nicotine-poisoning. About the only changes that will be found are congestion of the brain, liver, and lungs. The heart is empty, and a diffused redness may be seen over the mucous surfaces of the stomach and bowels. The blood is dark and fluid. This latter sign is about the only constant one.

Resistance to Putrefaction.—Nicotine may be detected in the body after a considerable length of time. In animals it has been found to exist even after the lapse of several years.

Tests.—The alkaloid responds to most all of the reagents for alkaloids, producing precipitates with picric acid, iodine, etc.

(1) Nicotine is distinguished from the ordinary alkaloids, with the exception of coniine, by its oily consistence and non-crystalline state; further, its odor is characteristic.

(2) If an ethereal solution of iodine is added to a solution of nicotine in ether, long ruby-red crystals are thrown down and deposited. These appear at once if the nicotine solution contains one per cent. of the alkaloid; otherwise, a few hours will be necessary for their complete formation.

(3) *Corrosive Sublimate Test.*—This substance produces a white crystalline precipitate with a solution of nicotine. It is at first amorphous. The other alkaloids, coniine included, which cause precipitates by the same reagent are distinguished from that occasioned by nicotine by remaining amorphous. Strychnine gives a crystalline precipitate, but its crystals are insoluble in acetic acid, while those of nicotine are not.

(4) *Hydrochloric Acid Test.*—If a watch-glass be moistened with a drop of hydrochloric acid, and placed over a second glass containing a little nicotine, an amorphous solid is deposited, while white fumes are rapidly evolved. Nicotine may be thus distinguished from coniine.

Nicotine may be tested physiologically by noting the effect produced on placing a small quantity of nicotine—a drop or so—upon the tongue of a cat or dog. Death usually follows in from one to two minutes.

Toxicological Examination.—The stomach contents, or one of the other organs, such as the liver, kidney, etc., should be finely comminuted

or subdivided, and water added in sufficient quantity to make a thin paste. The mixture should then be acidified by the addition of acetic acid and heated on a water-bath, when it is strained, the liquid evaporated to a small bulk, and four times its bulk of alcohol added. The insoluble material is next separated by filtration, and the latter heated to get rid of the alcohol. The next process consists in adding a little water to the residual liquid, again filtering it, and alkalizing the filtrate with potassium hydrate. The whole is then shaken with twice its volume of ether, and the latter, when properly separated, allowed to evaporate on watch-crystals, when nicotine, if present, will be observed in the form of oily streaks or drops, which should be dissolved in a little water and submitted to the tests already described. The odor of nicotine is very characteristic.

TOBACCO-SMOKING.—The excessive smoking of tobacco has resulted in fatal symptoms, and where the smoke has been diffused through water and swallowed, it has caused death. Dyspepsia and extreme nervous symptoms frequently follow the use of tobacco, and, where smoking has been carried to excess, paralysis of the portio dura. Persons not accustomed to the use of this plant are easily affected, and decided symptoms of poisoning may occur, and frequently fatal results follow.

Some authorities regard the active poisonous agent in tobacco-smoke as a product of the decomposition of the alkaloid (nicotine) ; others assert that the harmful effects are due to carbonic oxide, a poisonous constituent of the smoke; others doubt the existence of nicotine in the smoke at all; and still others claim that they are occasioned by the presence of the vapor of cyanide and sulphide of ammonium.

Cigarette smoking is decidedly more injurious to the system than either pipe or cigar smoking, probably on account of the inhalation of the poison into the lungs, the blood being thereby rendered noxious by the carbonic oxide.

LOBELIA.
(Indian Tobacco.)

Lobelia is a native of the United States, and is derived from the Lobelia inflata (nat. ord. *Lobeliaceæ*). The seeds and leaves are the parts employed, and owe their activity to the fixed alkaloid, *lobeline*. Lobelia also contains an acid, *lobelic*, fixed and volatile oils, etc. This alkaloid exists as a yellowish liquid with an aromatic odor, being lighter than water. It possesses most of the properties of nicotine, and is precipitated from its solutions by tannic acid. It is soluble in water, alcohol, and ether, and has an alkaline reaction, forming soluble salts with acids.

In *large doses* it produces nausea, violent vomiting, with great depression, feeble pulse, muscular relaxation, and sometimes purging. In *lethal doses* there are collapse, coma, frequently preceded by convulsions, and death from paralysis of the centre of respiration. The *treatment* consists in the administration of emetics, tannic acid, morphine, ammonia, alcohol, and counter-irritation to the surface.

Lobeline does not produce on animals the emetic effect of the plant. The detection of the seeds or parts of the leaves would aid materially in the diagnosis.

HEMLOCK.

(Conium.)

The Conium maculatum (*spotted hemlock*) is a native of both the United States and Great Britain. It belongs to the nat. ord. *Umbelliferæ*, and owes its activity to *coniine*, an alkaloid found in all parts of the plant, combined with an organic acid. It exists in the fruit in the proportion of five-tenths to two per cent. It also contains *conhydrine* and *methyl-coniine*. The seeds, leaves, and root are all poisonous, the fresh leaves being often mistaken for parsley, which it somewhat resembles. Its action is variable.

Symptoms.—In poisonous doses it intensifies the effects resulting from the administration of medicinal quantities. The alkaloid acts more energetically than the crude drug. There is dryness and constriction of the throat, headache, drowsiness, difficulty in keeping the eyelids raised, and disordered vision from paralysis of accommodation. There is a peculiar tingling sensation along the muscles, and gradually complete paralysis of the extremities ensues. This extends to the respiratory muscles, and the patient dies from apnœa. Occasionally delirium, coma, and convulsions exist.

Treatment.—Prompt emesis and active stimulation. Subsequently, artificial respiration should be resorted to if necessary.

Fatal Dose and Period.—Serious results have followed the administration of one-fifth of a grain of coniine, and a drop has proved equally disastrous.

The action of both the crude drug and the alkaloid is rapid, and fatal results may follow the ingestion of the poison within an hour or two.

Post-Mortem Appearances.—These are negative. There may be congestion of the lungs or of the brain. The blood is usually dark and fluid.

Tests.—(1) The odor is very penetrating, and may be detected in the proportion of 1 part to 50,000 parts of water.

(2) If a mixture of bichromate of potassium and dilute sulphuric acid is added to coniine and heated, butyric acid is formed and readily detected by its odor.

(3) Copious white fumes are generated by the union of hydrochloric acid and the alkaloid. This is accomplished by placing a trifle of hydrochloric acid in a watch-crystal and putting it over a similar glass containing a small quantity of coniine.

(4) If a solution of alloxan is added to coniine, a purple color results, with the separation of white, needle-shaped crystals. These latter dissolve in a solution of potassium hydrate and produce a purple color and a mousy odor.

Toxicological Examination.—Search should be made for particles of the leaves or seeds of the plant in both the stomach and intestines. The leaves are often taken for those of parsley. They should be rubbed in a mortar with potassa to develop the characteristic mousy odor. Then distil,

and examine the latter before resorting to the process for the detection of the poison. This has already been described under tobacco and nicotine.

The residue should be purified before resorting to the regular tests. This may be done by dissolving it in dilute acetic acid, filtering, rendering it alkaline, and agitating it with ether. The latter should be allowed to evaporate spontaneously. If the result is an oily liquid with the mousy odor, it may be tested with the regular reagents already mentioned.

A ptomaïne has been discovered that possesses most if not all of the properties of coniine.

WATER HEMLOCK.

(Cowbane.)

The root of the water hemlock (*Cicuta virosa*) has been frequently the cause of poisonous symptoms, and even death. It has been mistaken for parsley. The *symptoms* occasioned by this poison are dilatation of the pupils, tetanoid convulsions, vomiting, diarrhœa, insensibility, and coma.

The *post-mortem examination* generally reveals corrosion and perforation of the stomach. The *Phellandrium aquaticum* (fine-leaved water hemlock) may also be mistaken for parsley.

ŒNANTHE CROCATA.

(Hemlock Water-Dropwort.)

This is a very poisonous plant. It somewhat resembles common celery, but its root is more like the parsnip. Fatal results have followed the swallowing of a small piece of the root, the symptoms being acute pain, tetanic spasms, with the signs of intestinal irritation. Like all the other species of hemlock, this plant belongs to the order *Umbelliferæ*. The *Æthusa cynapium* (Fool's parsley), or Lesser hemlock, is also a poisonous substance, having been mistaken for parsley, and its roots for young turnips. Its symptoms are heat in the mouth, nausea and vomiting, headache, trismus, dilatation of the pupils, and stupor.

ACONITE AND ACONITINE.

Aconite is the tuberous root of Aconitum napellus (nat. ord. *Ranunculaceæ*), and is indigenous in Europe, but is cultivated in this country. It is commonly known as monkshood or wolfsbane, or blue-rocket. *Aconitine* is the principal alkaloid, although others have been discovered,—viz., aconine, pseudaconitine, pseudaconine, and picraconitine. These latter are unimportant. The root of the plant is the most poisonous part, its shape being very similar to that of the carrot, although it has been frequently mistaken for that of the horseradish. It differs from the latter, however, in its appearance and general properties. The root has been administered with criminal intent in more than one instance, its powder being mixed with pepper or other substances and sprinkled over food.

Aconitine, the active alkaloidal principle of Aconitum napellus, is found in all parts of the plant, but it occurs principally in the root, the amount ranging from one-tenth to six-tenths per cent. In the pure state aconitine is

probably the most deadly poison known. It occurs as a colorless, odorless, crystalline substance, with an acrid taste. Much of the aconitine as found in commerce is exceedingly variable in strength and appearance, sometimes being totally inert. It is slightly soluble in water, quite so in alcohol and chloroform, but is insoluble in ether. It has the power of neutralizing acids to form salts, most of which are soluble in water and alcohol.

Symptoms.—When applied *locally*, aconite, or its alkaloid, produces a numbness of the sensory nerves, and causes a tingling sensation. Death has followed such applications. After poisonous doses have been taken, the symptoms are sometimes so characteristic that the diagnosis can be made from them alone.

Immediately or soon after swallowing there is a sensation of numbness and tingling in the lips, tongue, and extremities, followed by a feeling of weakness. Dryness of the throat is an early symptom, and is soon followed by nausea and vomiting, with pain and tenderness of the epigastrium. Sensibility soon becomes diminished or entirely abolished; there is ringing in the ears and deafness, with dimness and, occasionally, loss ot sight. The muscular prostration is occasionally so intense that the patient is unable to walk. The pulse is slow and feeble, and respiration extremely difficult. The countenance is anxious, and a cold perspiration covers the body. The pupils are generally dilated, and the mind remains clear to the last. Death usually occurs suddenly, either from shock, asphyxia, or syncope. Delirium is rare. The above symptoms are subject to variation. Purging is sometimes present.

Treatment.—The contents of the stomach should be evacuated early, and the stomach washed out by the stomach-pump. The solubility of the poison may be arrested, to a certain extent, by the administration of a solution of iodine in iodide of potassium. The patient should be kept perfectly quiet, with his head in a low position. Administer heart stimulants, such as ammonia, ether, or alcohol, and give digitalis hypodermatically. Artificial heat may be necessary to keep the patient warm.

Fatal Dose.—On account of the variable strength of the various preparations, the fatal quantity is uncertain. One-sixteenth of a grain of the alkaloid has occasioned fatal results; one-half of this quantity might cause death in some instances. The one-fiftieth of a grain nearly caused death in an elderly lady. (Pereira.) The alkaloid is much more poisonous when administered subcutaneously.

Four grains of the extract and twenty-five drops of the tincture have produced death. Fatal results might also follow even smaller quantities, provided very active preparations are employed. Recoveries have followed comparatively large quantities of both aconitine and aconite. Severe symptoms have even resulted from the inhalation of the dust of aconite during the process of reducing the root.

Fatal Period.—Death usually is very rapid after large doses have been taken. The symptoms appear in a few minutes, or may be protracted to

one or two hours. Fatal results follow, as a rule, within three or four hours. In one instance death occurred in eight minutes, and in others within an hour. On the other hand, it may be deferred for twenty-four hours, and one case is reported where the patient lingered for four days. (Mallet.)

Post-Mortem Appearances.—The results of autopsies are by no means of a characteristic nature. There may be general venous congestion, with more or less congestion of the lungs and liver. The brain and its membranes are frequently found in an injected state, and the stomach and intestines reddened. The right side of the heart contains more or less dark and fluid blood.

Tests.—There is no reliable test for aconitine. The best test is the physiological action of the poison on the tongue, which is very marked and quite characteristic. Minute portions of the alkaloid in solution produce a tingling or numbness when applied to the tongue. This sensation may continue for some hours. The effect may be produced by the one-sixteen-hundredth of a grain. One-hundredth part of a grain, dissolved in spirit and rubbed into the skin, may produce the same effects. A mouse may be killed by the subcutaneous injection of the one-three-thousandth of a grain of aconitine.

The poison responds to most of the tests employed for the alkaloids, and is precipitated by picric acid, tannic acid, etc.

Toxicological Examination.—Careful search should be made for parts of the plant, since the poisoning may be due to any one of these parts. The process already described under nicotine should be employed here for the detection of the poison. The residue thus obtained should be dissolved in a few drops of water, and slightly acidulated with acetic acid. It is then submitted to the physiological test.

Medicinal Preparations.—The following is a list of the various preparations and their doses:

Abstractum aconiti (*abstract of aconite*). Dose, gr. ss to i.
Extractum aconiti (*extract of aconite*). Dose, gr. ⅛ to ss.
Extractum aconiti fluidum (*fluid extract of aconite*). Dose, ♏ss to ii.
Tinctura aconiti (*tincture of aconite*). Dose, ♏i to v.
Aconitine, not official; it should not be employed internally, on account of its poisonous properties. Dose, gr. $\frac{1}{500}$ to $\frac{1}{200}$. It is sometimes used as a liniment (gr. ii to f℥i).

PHYSOSTIGMA.
(Calabar Bean.)

Physostigma is the seed of Physostigma venenosum (nat. ord. *Leguminosæ*), a plant existing on the western coast of Africa. It owes its activity to an alkaloid called *eserine*, or *physostigmine*, which is found in the cotyledons. Another alkaloid, *calabarine*, has been isolated, but it is probably a derivative alkaloid of eserine.

When the active principle of the plant is treated with nitric acid or per-

chloride of iron, an orange and a brown color are respectively produced. The alkaloid is found as a crystalline, colorless, bitter solid, which is somewhat soluble in water, and readily so in alcohol, benzol, ether, and chloroform.

Symptoms.—These are opposite to those occasioned by strychnine, as the action of physostigmine is that of a spinal depressant. It causes giddiness, great muscular weakness, a slow and often irregular pulse, nausea, and occasionally vomiting. There is generally free purgation, and the pupils are usually in a state of contraction. Muscular twitchings and the abolition of the reflex action, slow respiration, myosis, and motor paralysis precede death, which occurs from respiratory failure. The mind is generally clear throughout the course of the symptoms.

Treatment.—Administer emetics and cathartics. The use of the catheter is advised, to prevent the further absorption of the poison. As a physiological antagonist, atropine should be subcutaneously employed.

Fatal Quantity.—Death followed the swallowing of six of the beans by a boy of six years.

Post-Mortem Appearances.—These are negative.

Tests.—The most important test is the *physiological*. A drop or two of the suspected liquid is dropped into the eye of a rabbit or other small animal, when in the course of a few minutes (ten or fifteen) contraction of the pupil will be observed. This effect is of diagnostic importance in noting the difference of the poison from coniine, atropine, hyoscyamine, or daturine.

According to Dragendorff, less than one-thousandth of a grain of the alkaloid will produce a red color with bromine in bromide of potassium.

The poison may be separated from the tissues by a modification of Stas's process, the ultimate solvent used being benzene instead of ether. (Dragendorff.)

CHAPTER XV.

(3) *ASTHENICS.*

HYDROCYANIC OR PRUSSIC ACID.

Sources—Symptoms—Treatment—Quantity required to destroy Life—Fatal Period—Post-Mortem Lesions—Chemical Analysis—Toxicological Examination—Quantitative Determination—Cyanide of Potassium.

Hydrocyanic acid is one of the most formidable poisons with which we have to deal. It exists in bitter almonds, wild cherry, peach kernels, apricot kernels, the pips of apples, and the flowers and leaves of cherry laurel, peaches, etc. In this concentrated state it is a limpid, colorless, extremely volatile liquid, having an odor resembling that of oil of bitter almonds. It is a compound of cyanogen and hydrogen (HCy), and is one

the deadliest of poisons. The *diluted* acid is formed by the action of ater and sulphuric acid on potassium ferrocyanide, or of hydrochloric acid n chloride of silver; it is a colorless, volatile fluid, and contains about two er cent. of the concentrated acid. It possesses great medico-legal interst, as it is so frequently the cause of death. *Scheele's acid* is of the averge strength of five per cent.; but it often happens that both of the acids re totally inert, probably on account of exposure to light, which decomposes them. The *French acid* has a strength of ten per cent.

Symptoms.—When applied locally, the concentrated acid transudes the cuticle and paralyzes the end organs of the sensitive nerves beneath. The inhalation of the vapor, or the ingestion of large quantities of the poison, may produce instant death. If the poisonous dose has not been large enough to arrest the circulation instantly, giddiness and loss of muscular power occur, and the patient staggers and falls to the ground. Dyspnœa and depression of the heart take place, followed by dilatation of the pupils, the eyes being glassy and protruded; the extremities are cold, and sometimes the bladder and rectum are evacuated involuntarily. The convulsions which take place are of cerebral origin. A point of importance to remember is that unconsciousness is not always immediately produced, nor is the utterance of a cry or shriek characteristic of poisoning by this agent. Toward the end respiration is convulsively performed, and asphyxia soon sets in, being due to paralysis of the respiratory centre. The face is usually pallid or livid, and the jaws may be spasmodically closed, as in tetanus. Often there is frothing at the mouth, which is sometimes bloody. The odor of the poison can be detected in the breath. The patient occasionally passes away during a severe convulsion, or death is preceded by coma, with stertorous breathing. The latter symptom might lead the observer to mistake the trouble for apoplexy.

Treatment.—The effects of the poison are usually so rapid that there is scarcely any time left for treatment. However, the stomach contents should be evacuated as soon as possible and cold water dashed over the face and chest. This should be succeeded by the free inhalation of ammonia, given by the mouth or by intravenous injection. Stimulants should be given both externally and internally. Atropine hypodermatically, as a respiratory stimulant, is advised. A mixture of the ferrous and ferric sulphates may be tried as an antidote, to be followed by a solution of carbonate of potassium. This combination produces in the stomach the inert Prussian blue.

Quantity required to destroy Life.—The smallest recorded quantity is nine-tenths of a grain of the anhydrous acid, which is equal to about forty-five minims of the official acid. On the other hand, recovery has taken place after the administration of one drachm of Scheele's acid, which is equivalent to two and four-tenths grains of anhydrous acid. The inhalation of the vapor has caused death, as before stated.

Fatal Period.—Death may occur instantaneously, but the period is

modified by various circumstances. Ten or fifteen minutes generally elapse before death in the majority of cases. In one case an hour elapsed before the fatal termination. Instances are recorded of persons, after swallowing fatal doses of the poison, doing certain acts, such as replacing the cork in the bottle, fixing the bedclothes, or even walking into another room, etc. To show the rapidity with which consciousness is lost, Hufeland mentions a case where a full-grown and healthy person, about to be arrested as a thief, swallowed an ounce of the poison, staggered a few steps, and fell to the ground, being dead within five minutes.

Post-Mortem Lesions.—The post-mortem appearances are inconstant and not characteristic. The stomach may be normal or congested. The most frequent sign after death by this poison is a general venous congestion. In some cases the odor of hydrocyanic acid may be noticed in the stomach or other parts of the body, or it may be absent in the former organ and present in other parts. The liver, kidneys, lungs, and spleen are often gorged with blood, and the arterial system is empty.

The brain may show turgescence of the vessels, and there may be an effusion into the ventricles. The bile has been found to be of a deep-blue color in some instances, and the blood black, fluid, or coagulated, the odor of the poison being readily recognized.

Chemical Analysis.—(1) The addition of a solution of nitrate of silver to a solution of hydrocyanic acid produces a white precipitate which is entirely soluble in boiling concentrated nitric acid. It is further distinguished from the *white chloride* by its form, prisms or needles (the chloride is amorphous); by its being sparingly soluble in ammonia (the chloride is very soluble); by the permanence of its color when exposed to light (the chloride becoming dark-colored), etc. The cyanide of silver may be further known by the giving off of cyanogen gas and by its purplish flame if it be well heated and dried.

(2) If a little liquor potassæ is added to the suspected liquid, and then a mixture of ferrous and ferric sulphates, a dirty greenish-blue precipitate is produced, which becomes clear Prussian blue on the addition of a few drops of pure hydrochloric acid, should hydrocyanic acid be present.

(3) If a solution of hydrocyanic acid is treated with ammonium sulphide, and gently heated, a white sulphocyanide of ammonium is produced; if this is then touched with a drop of persulphate or perchloride of iron, a blood-red sulphocyanide of iron is formed. This test is characteristic in the absence of meconic acid. (*Liebig's test.*) It is best adapted for discovering the poison in a state of vapor. A drop of ammonium sulphide in a watch-crystal is inverted over a vessel containing the suspected liquid, which may be gently warmed by immersion in warm water, or by the hand, when the vapor will rise. This is permitted to evaporate until it has nearly dried, after which it is touched with a drop of the iron salt, which will immediately give rise to the characteristic blood-red color.

(4) The suspected liquid, rendered slightly alkaline by liquor potassæ,

is treated with a dilute solution of cupric sulphate, when a greenish-white precipitate is formed, which changes to white on the addition of a few drops of hydrochloric acid. This reaction may be used also for the acid in the vapor state, as follows: If a drop of the cupric sulphate solution is placed on a watch-crystal, and alkalized, the addition of a drop of the suspected fluid will produce the characteristic color if the poison be present.

Toxicological Examination.—The attempt should be made to detect the odor of hydrocyanic acid in the stomach. The latter, together with its contents, and other viscera, should be distilled at a comparatively low temperature, and, if the material is alkaline, diluted sulphuric or some other acid should be added[1] previously. The rising vapors are then collected in a cool receiver, and, if the amount be small, caustic potash or nitrate of silver may be placed in the retort, thus *fixing* the acid by the production of potassium or cyanide of silver. Or, the method described above may be followed as far as the acidifying process, when any of the vapor tests may be applied to the rising acid.

Quantitative Determination.—Nitrate of silver throws down free hydrocyanic acid, and for the determination of the weight the resulting cyanide is washed, dried, and weighed, when every 100 parts will be found to represent 20.15 parts of the anhydrous acid.

Cyanide of Potassium.—This salt of prussic acid is employed by photographers, electrotypers, etc., and has frequently been the cause of poisoning. It occurs in commerce as a white, deliquescent salt, or in crystalline masses, very soluble in water, less so in alcohol, and evolving the characteristic prussic acid odor. Its reaction is alkaline. Its action is similar to prussic acid; three to five grains will kill as rapidly as the acid just mentioned.

Chemical Analysis.—With acids it is decomposed with the giving off of prussic acid. Nitrate of silver produces the white cyanide of silver with potassium cyanide. Tartaric acid precipitates the potash, as also does bichloride of platinum. Iron and copper (*vide* prussic acid tests) may be applied to detect this substance, but the alkalizing agent must be left out.

Prussic acid may be obtained from organic mixtures by neutralizing with dilute sulphuric acid and distilling.

The *symptoms*, *treatment*, and *post-mortem appearances* are similar to those of prussic acid.

Cyanide of mercury also causes poisonous symptoms, but these are allied to those of corrosive-sublimate-poisoning.

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[1] In medico-legal cases of suspected poisoning by hydrocyanic acid, where the most careful accuracy in the analysis is demanded, the employment of any acid in the distilling process is discountenanced, since it may be impossible to discover whether the poison was actually present in the free state in the stomach, or "formed" by the analyst out of the potassium sulphocyanide existing in the saliva.

OIL OF BITTER ALMONDS.

This substance has a pungent, prussic acid smell, and a light-yellow color. It is somewhat heavier than water, but is slightly soluble in it, but more so in alcohol and ether. The *essence of bitter almonds* is a solution of this oil in alcohol, and is a poisonous fluid. The oil exists in the bitter almond as a result of the reaction of water upon amygdalin and emulsin constituents of the nut, and is obtained therefrom by distillation. Its poisonous effects are due to prussic acid.

The *symptoms*, *treatment*, and *post-mortem lesions* are like those of hydrocyanic acid. Twenty drops may be stated as a fatal quantity.

CHERRY-LAUREL WATER.

This is obtained by distilling the leaves of the *Prunus lauro-cerasus* (cherry laurel). It contains an essential oil like that of the oil of bitter almonds, and owes its poisonous effects to hydrocyanic acid.

Cherry-laurel water has occasioned death in more than one instance.

Poisonous effects have likewise followed the ingestion of the kernels of the *cherry*, *peach*, and *apricot*. The *symptoms* are similar to those occasioned by a small dose of hydrocyanic acid.

NITRO-BENZOLE.
(Essence of Mirbane.)

Nitro-benzole results from the action of nitrous acid upon benzole. It is employed in confections and perfumery as a substitute for the bitter almond oil, and is a powerful narcotic, the effects of which are similar to those of prussic acid. It occurs as a pale-yellow liquid, with the odor of bitter almonds. Its vapor is exceedingly powerful.

It is known from the bitter-almond oil by the action of strong sulphuric acid upon it. A few drops of bitter-almond oil and of nitro-benzole are poured upon a saucer, and a drop of sulphuric acid added, when the almond oil acquires a crimson hue with a yellowish border, while the other fluid is unaffected. Nitro-benzole, when mixed with organic substances, may be separated by adding sulphuric acid and distilling.

DIGITALIS AND DIGITALIN.

Digitalis is a native of Europe, but is cultivated in this country. It is the leaves of Digitalis purpurea, or purple foxglove (nat. ord. *Scrophularineæ*), and is obtained from the second year's growth. The seeds, leaves and roots are poisonous, the leaves being used in medicine. The active principles of the plant are due to several glucosides, called *digitalin*, *digitoxin*, and *digitalein*. Digitonin, another glucoside, resembles saponin in its effects.

Symptoms.—In toxic doses, digitalis produces symptoms referable to the heart and the gastro-intestinal tract. The poisonous effects are nausea, vomiting, and purging. There are severe abdominal pains, vertigo, heat in

the head, and dimness or loss of sight. The pupils are dilated and insensible, and the pulse slow, irregular, and weak. Prostration and a tendency to syncope come on, the eyes being prominent and fixed. Occasionally there is suppression of the urine. Death is usually preceded by delirium, stupor, and convulsions. Sometimes the symptoms of the gastro-intestinal tract are more prominent than those of the heart, and *vice versa*. The heart is generally arrested in systole.

Treatment.—Emetics and cathartics should be administered, to remove the poison from the system. As a chemical antidote, tannic acid is advised, and as physiological antagonists, ammonium carbonate, alcohol, opium, or saponin.

Fatal Quantity and Period.—As digitalis is a *cumulative* poison, the effects may not appear until a number of doses have been taken. It is extremely difficult to state the fatal dose. Eight or ten grains of the powdered leaves have occasioned dangerous and even fatal symptoms. Half a fluidounce of the tincture and as much as a drachm of the powder have been taken without producing untoward symptoms.

Post-Mortem Appearances.—These are not very characteristic. Congestion of the brain and its membranes and inflammation of the mucous membrane of the stomach are sometimes seen, but often these are absent.

Chemical Analysis.—Digitalin and digitoxin are the most important of the active principles of the crude drug. They appear in the form of colorless crystals of neutral reaction. They have an intensely bitter taste, and are very sparingly soluble in water, benzene, and ether; they, however, dissolve readily in alcohol and chloroform.

(1) *Lafon's Test.*—If a few drops of a mixture of equal parts of sulphuric acid and alcohol are heated with digitalin, a light yellowish-brown color is produced. If a drop of dilute solution of ferric chloride is added, the color is changed to blue or greenish blue.

(2) *Grandeau's Test.*—If digitalin is dissolved in concentrated sulphuric acid, it yields a green color, which on the addition of bromine-water changes to a reddish violet, and on dilution with water to an emerald-green.

Neither of these tests is characteristic, and we are obliged to depend on the physiological effects of the drug.

(3) *Physiological Test.*—If some of the ultimate extract of the suspected material is injected hypodermatically into a frog or other small animal, there is soon noticed a gradual irregularity and slowness of the heart-beats, with final stoppage in the state of strong systole of the ventricle. The pure digitalin should be injected under the skin of a second frog, and the two experiments compared.

Toxicological Examination.—Careful search should be made for particles of the leaves in the vomited matters and in the stomach and intestines. If the tincture has been taken, the odor may be detected, and the membrane of the stomach may show a greenish color.

The suspected material should be mixed with alcohol and acidified with

acetic acid. It is then digested on a water-bath and filtered, and the latter evaporated to dispel the alcohol. The aqueous fluid is mixed with petroleum ether and shaken, to dissolve out the impurities, such as foreign bodies, etc. The ether is then separated, and the remaining liquid shaken with chloroform. This is allowed to evaporate spontaneously, when the toxic principles of the drug will be left behind.

Part of the residue should be injected subcutaneously into a dog or cat, and the effects noted. Another portion may be administered to a frog, and its exposed heart watched. Pure digitalin is then administered to another frog for comparison. If these tests are positive, a portion of the chloroform extract may be subjected to the regular tests.

Medicinal Preparations.—

Abstractum digitalis (*abstract of digitalis*. Dose, gr. ss.
Extractum digitalis (*extract of digitalis*). Dose, gr. ¼, gradually increased.
Extractum digitalis fluidum (*fluid extract of digitalis*). Dose, ♏i.
Tinctura digitalis (*tincture of digitalis*). Dose, ♏v to x, gradually increased.
Infusum digitalis (*infusion of digitalis*). Dose, f℥ss to iv.

COCCULUS INDICUS.
(Levant Nut.)

Cocculus indicus is the berry of the *Menispermum cocculus*, or *Anamirta cocculus*, imported from the East Indies. It is used for destroying vermin, and also to give malt liquors their characteristic bitter taste. Cocculus indicus owes its poisonous properties to the presence of *picrotoxin*, a neutral principle. The action of both the crude drug and its active agent is that of a gastro-intestinal irritant.

Cocculus indicus belongs to the nat. ord. *Menispermaceæ*.

Picrotoxin is a crystalline, colorless substance which is somewhat soluble in water, and constitutes about one per cent. of the seeds of the plant. It is very soluble in alcohol, ether, chloroform, and amylic alcohol. Cold sulphuric acid has no effect on it, but the hot acid gives it an orange-yellow color. Nitric and hydrochloric acids have no effect on it. When it is boiled with sulphate of copper and potassa it acts like grape-sugar. Picrotoxin is not an alkaloid, but is said to belong to the glucosides.

Symptoms.—These appear to be, in some cases, nausea, vomiting, and severe abdominal pain. There is loss of voluntary power, but consciousness remains for some time. In some cases there are convulsions and a scarlatinal eruption. The convulsions bear a resemblance to those occasioned by strychnine.

Treatment.—Evacuate the stomach thoroughly. For the convulsions, if present, give chloral or chloroform.

Toxicological Examination.—The liquid or suspected material should be exhausted with alcohol and evaporated to a small bulk. The residue is then extracted with chloroform, which, upon evaporating, will deposit the

ystals of picrotoxin. These may be recognized by the brick-red color hat they produce when mixed with an excess of potassium nitrate, the mixture being moistened with a little sulphuric acid and a strong solution f sodium hydrate; or the suspected material may be administered to imals and the physiological effects noted.

CYTISUS LABURNUM.

The seeds of this plant are frequently eaten by children with poisonous ects. It contains an active principle, *cytisine*. The symptoms are irrita-ı of the alimentary canal, dilatation of the pupils, rigidity of the extremi-, and convulsions. Cytisus laburnum is a very common shrub of Great tain. The parts of the plant generally used are the bark and seeds.

TAXUS BACCATA.
(The Yew.)

Symptoms of irritant narcotic poisoning are occasioned by the leaves and ries of this plant. It is sometimes used as an abortifacient on account its action on the bowels, thus indirectly stimulating the uterus to con-ction. The poisonous properties of this plant are due to an alkaloidal nciple, *taxine*, which has the power of destroying life by paralyzing the piratory centre. The symptoms produced are usually accompanied by ensibility and convulsions.

Other vegetable poisons of little importance are *Ligustrum vulgare* (the ivet), *Ilex Aquifolium* (holly), and *Viburnum Opulus* (Guelder rose).

CHAPTER XVI.

PTOMAÏNES AND OTHER PUTREFACTIVE PRODUCTS.

eneral Remarks—Substances whose Reactions are Similar to those of the Vegetable Alkaloids—Poisons formed during the Process of Putrefaction—Embalming from a Medico-Legal Stand-Point.

Ptomaïnes are the basic products derived during the process of decay animal and vegetable substances; in other words, they are the products putrefaction. Like the vegetable alkaloids, they may be either volatile or ot. Some of the ptomaïnes contain oxygen, and all possess nitrogen as a emical constituent. The former correspond to the *volatile* vegetable alka-ids coniine and nicotine, and the latter to the *fixed* alkaloids.

Putrefaction is due to the presence of bacteria, which, by dividing pre-xisting complex compounds of the body, generate ptomaïnes. The forma-ion of the various kinds of these products will depend upon the nature of he material acted on, together with the conditions under which the process

of putrefaction advances. The putrefactive changes produced in the *absence* of air, and their products, are phenomena chiefly of interest to the legal physician, as it is now generally understood that experiments made upon tissues permitted to decompose in the presence of an unlimited supply of air are negative in their results,—are worthless.

The presence of bacteria in certain parts of the alimentary canal, as well as in other cavities of the human body, is a fact now generally accepted. After death they are said to multiply with wonderful rapidity, extending their growth until the entire body is encompassed within their influence.

Ptomaïnes are found more or less in every organ with which the toxicologist has to deal, and it is of importance that he be familiar with the nature of these substances, as it might readily happen that one of these ptomaines might be encountered when searching for one of the alkaloids in a decomposed body in a case of alleged poisoning.

Certain albuminoid bodies and peptones occasionally produce substances which are analogous to the cadaveric alkaloids, differing from them only in that their generation is independent of putrefaction. Certain organic acids, also, have been identified, which may confuse the toxicologist when making his tests for vegetable alkaloids.

The number of known ptomaïnes has multiplied considerably with the march of medical science, and the toxicologist is now confronted with an array of substances which, if he be ignorant of their nature, might interfere with the ends of justice.

Among the known ptomaïnes may be mentioned the following: tyrotoxicon, mydatoxine, neurine, neuridine, cadaverine, muscarine, mydaleine, saprine, putrescine, sepsine, collidine, hydrocollidine, typhotoxine, methylguanidine, mydine, mydatoxine, tetanine, tetanotoxine, spasmotoxine, tetanus toxalbumins, trimethylenediamine, ethylidenediamine, isoamylamine, ethylendiamine, fugin, ptomo-muscarines, etc.

They are by no means all poisonous, but for those of a toxic nature certain affixes have been proposed. For example, the affix "toxine" is used to denote the poisonous character of such a substance, as typhotoxine, mydotoxine, etc.

In making an analysis in a case of poisoning, it is of the greatest importance that the reagents to be employed are of the purest kind. So-called chemically pure reagents frequently contain impurities, which often interfere with their ultimate success during experimentation. This is particularly the case when alkaloidal solvents are used. Vaughan,[1] of Michigan, observed that several samples of German ether with which he experimented yielded alkaloidal reactions, and he further states that commercial alcohol contains an alkaloidal substance possessing an odor similar to that of nicotine and pyridine. Haitinger found five-tenths per cent. of the latter substance in amylic alcohol.

[1] Hamilton's System of Legal Medicine.

Ptomaïnes have been found to exist in yeast which has undergone putrefactive changes, in poisonous sausages, ice-cream, cheese, decayed meat and fish, sea-mussels, etc. Those found in various kinds of food are possessed of great toxic powers and are extremely poisonous to man. The actions of ptomaïnes as found in decomposing viscera are subject to great variation. Thus, the ptomaïne mydatoxine produces paroxysmal convulsions, diarrhœa, and dyspnœa. That of mydaleine causes a marked rise of temperature, etc.; and so on with other such products. Poisonous bases (compounds of ptomaïnes and arsenic,—*arsines*) have been extracted from persons who have been fatally poisoned by arsenic, one of which was volatile, while the other acted similarly to the alkaloid strychnine.

What is chiefly of importance to the medico-legal expert is the fact that these putrefactive products might occasion serious doubt in a case of suspected poisoning by the vegetable alkaloids. After the most careful analysis in such an instance, mistakes are liable to occur, such as reporting the existence of a poison when it is not present, whereby an innocent person could be made to suffer unjustly.

There are various substances which bear a striking resemblance in their reaction to the vegetable alkaloids, and these are necessarily of great importance to the toxicologist. The alkaloids which are thus apparently *duplicated* in their various actions are atropine, coniine, morphine, nicotine, strychnine, digitalin, colchicine, delphinine, and veratrine.

Atropine.—Zulzer and Sonnenschein mention a putrefactive substance possessing decided mydriatic properties, and the power, when given internally, of increasing the cardiac action, and preventing, more or less, the peristaltic movements of the intestines. Ptomatropines, as these products are scientifically named, have been found in corned beef, poisonous sausage, decomposing fish, and putrid game.

The *symptoms* produced by them are very much like those occasioned by atropine. There are dryness of the fauces, great thirst, red and swollen gums, with partial paralysis of the muscles of deglutition; other symptoms are marked dilatation of the pupils, paralysis of accommodation, drooping of the eyelids, and strabismus. The tongue is coated and the bowels constipated. The action of the heart is at first increased, and then weakened. There are occasionally double vision and aphonia. General weakness is of common occurrence, and convulsions may appear. Death results from cardiac paralysis.

The *post-mortem lesions* are swelling of the pharynx, œsophagus, and mucous membrane of the stomach. There may be venous hyperæmia of the brain, lungs, and kidneys. Degeneration of the heart-muscle, together with injection of the intestines and swelling of the solitary and Peyer's patches, may exist.

It is generally believed that these substances are excreted with the urine in various diseases.

Coniine.—Substances having an oily, alkaline, and volatile property,

and which bear a close resemblance to coniine in their reactions, have been discovered by various experimenters. They are very bitter to the taste and highly poisonous.

Selmi obtained a ptomaïne from decomposing animal tissue which was coniine-like in many respects. He later succeeded in obtaining substances from a chloroform extract of the viscera of bodies buried six and ten months which yielded the mousy odor of coniine.

Morphine.—In the Buchanan trial for wife-poisoning, the chemists for the defence claimed that the morphine reactions submitted before the jury by the experts of the State could be duplicated with ptomaïnes formed in the decomposing human body. They further asserted that the chemicals used in the tests for the alkaloid must have extracted many substances similar in reaction to morphine. To further substantiate their views, experiments were carried on in open court, before judge and jury. Two bottles were presented, one containing a decomposing human pancreas and the other one-tenth of a grain of morphine in solution. These substances were submitted to the ferric chloride test, and the characteristic blue color produced. This is the decided morphine reaction. Subsequently the nitric acid and sulphomolybdic acid tests were applied, and with like results. The fact seemed apparent that the pure morphine had not produced such distinctive reactions as the putrefactive product generated in the human body; nevertheless the suspected individual was found guilty of murder in the first degree.

The above case recalls to the writer's mind another instance of similar behavior, in which all the reactions quoted in the case just referred to were found. Professor Vaughan received from the authorities at Lincoln, Nebraska, in 1890, a stomach and part of a liver, with instructions to look for morphine. He followed the method of Dragendorff, and obtained from the amylic alcohol extract from alkaline solution a residue which produced most of the color tests for morphine, but failed to produce morphine crystals; hence his report was "no morphine." It was subsequently learned that the cause of death was a blow upon the back of the head.

The citation of these two cases will be sufficient to demonstrate the importance of exercising the greatest care when examining tissues for morphine, for it has been proved over and over again that none of the morphine tests are conclusive evidence of the existence of poisoning when acting upon unknown complex mixtures. The presence of impurities is always liable to lead the analyst astray, and the presence of morphine should never be accepted as certain unless the pure morphine crystals are produced and the several tests verified. The residue to be subjected to chemical analysis should be thoroughly cleansed and freed from all foreign material.

Professor Vaughan[1] states that "the identification of morphine in the liver and other organs in cases of suspected poisoning is beset with difficul-

[1] Hamilton's System of Legal Medicine.

ot provided for by the methods now generally employed. Since the ances which vitiate the morphine tests are of bacterial origin, and since rial products vary with the conditions under which the germs producing grow, it is essential that the putrefactive changes which the tissue un-oes before the tests are begun should occur under the conditions as ly as possible which exist in the cadaver. . . . The upper portion of the l intestine (and the adjacent tissue after death) has a bacterial flora pe-r to itself. These tissues are the ones quite universally examined in ico-legal cases, and consist of the small intestine itself, the stomach, the , the pancreas, the spleen, and, in some instances, the kidneys. Of se the bacteria present in the small intestines during life may after death nd to all the abdominal and thoracic viscera."

Nicotine.—Wolckenhaar succeeded in obtaining from the decaying in-ines of a woman, dead six weeks, a nicotine-like substance of yellowish r, marked nicotine odor, and strongly alkaline reaction, but differing ome of its chemical reactions. Schwanert noticed a peculiar odor in mining the decomposing liver, spleen, and intestines of a child, and pro-ed in the ether extract from alkaline solution a small amount of a nico--like material which differed from that alkaloid only in its smell and ater volatility.

Strychnine.—A substance which is somewhat similar to strychnine in eactions has been detected in a decomposing body. This ptomaïne was hly poisonous, and produced a crystalline precipitate with iodized hy-odic acid, a red coloration with hydriodic acid, and the usual color test h sulphuric acid and potassium bichromate. This substance was slightly er, while strychnine is intensely so, even in the proportion of 1 part to 000 parts of water.

Paltauf and Heider state that the chronic disease known as *pellagra*, ich prevails in Lombardy and other near-by countries, is produced by the ction of the corn-meal used as food by the inhabitants of these coun-s with the bacillus maidis Cuboni and the bacillus mesentericus fuscus. tain ptomaïnes are generated by these bacilli which are soluble in alco- and possess the power of exciting the disease. Their reactions and siological effects are somewhat similar to those of strychnine.

In 1871, Lombroso discovered an alkaloidal substance (pellagrocine [1]) in uldy corn-meal which was insoluble in water, non-crystalline, unstable, and a whitish color, but soluble in ether and alcohol. Its color reaction with phuric acid and potassium bichromate was very much like that occasioned the alkaloid strychnine.

Digitalin.—Digitalin-like substances have been found in liver sausage, d Gunning states that they could be differentiated from digitalin by the sence of the characteristic bitter taste. A similar substance has been

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[1] *Pellagrocine* is composed of several ptomaïnes, some of which occasion nico-ne-like symptoms, and others produce narcosis and paralysis.

discovered in the brain of a man, by Trottarrelli, the residue of its sulphate producing an aromatic odor and astringent taste. When treated with sulphuric acid alone, and with the latter and hydrochloric acid, it struck a purple and dark-red color respectively.

Colchicine.—Brouardel and others have stated that ptomaïnes might be found in decomposing human bodies, which, when extracted, form reactions with nitric acid, and with a sulphuric acid solution of ammonium vanadate (200 parts of the acid and 1 of the vanadate), similar to those produced by traces of colchicum. Baumert discovered a substance in a supposed case of poisoning which occasioned most of the colchicine reactions, and a similar substance has been detected in beer.

Veratrine.—A veratrine-like ptomaïne has been extracted from a body which had been in water for a period of eighteen months. This substance produced the veratrine reaction when subjected to heat with sulphuric acid. However, it differed from the vegetable alkaloid in reducing ferric salts immediately, and in its negative results when injected into frogs.

Curarine.—A ptomaïne has been found in the putrefied human brain which produced paralysis of the terminals of the motor nerves in a similar manner to curarine. Bechamp obtained an alkaloidal body from the products of the pancreatic digestion which produced a carmine-red color, when treated with sulphuric acid, similar to that occasioned by veratrine. By subjecting this substance to digestion with gastric juice and extracting it, a substance was obtained which acted with sulphuric acid like curarine.

POISONS FORMED DURING THE PROCESS OF PUTREFACTION.

Tyrotoxicon.—This ptomaïne was discovered by Professor Vaughan, in 1884, in milk and cheese, and later in ice-cream and certain milk products. This powerful poison forms crystals with potassium hydrate, and when treated with a mixture of carbolic and sulphuric acids, produces a green color. As found in whey, the coloration may vary from yellow to orange-red.

Small doses of tyrotoxicon in man cause retching, vomiting, and purging and toxic quantities, hurried breathing, dilatation of the pupils, rapid pulse, and depression of temperature.

Typhotoxine.—This substance is produced by the Eberth bacillus of typhoid fever. It causes in mice and guinea-pigs increased respiration and slight salivation. Muscular incoördination and weakness follow, the animals being unable to stand. The pupils are strongly dilated, and fail to react to light. Fatal results follow in a day or two after the administration of the poison.

Mydaleine.—This substance, which is found in putrefying cadaveric organs, as the liver and spleen, causes the temperature to rise when it has been administered subcutaneously.

Neurine.—Neurine is found in decomposing animal tissue, and has an action somewhat like curare.

The substance discovered by Adamkiewicz is supposed to be the active agent in producing cancer. It was named *cancroin* by the discoverer, and is probably similar to neurine. This observer advocates the employment of cancroin in the treatment of cancer, after the Koch theory of consumption.

Susotoxine.—Novy extracted and isolated this base from cultures of the hog cholera bacillus. Its action seems to be confined to the centre of respiration. It slows this function, then increases it, and finally again retards it. Convulsive tremors may occur. One hundred milligrammes, hypodermatically injected, caused the death of a young rat within an hour and a half.

Choline.—This substance is often found in decomposing tissue. It causes muscarine-like symptoms, but its effects are not produced unless large doses are exhibited.

Methylguanidine.—This base is extremely poisonous. It was discovered by Brieger and Bocklisch in decaying flesh. The main effects of the substance are muscular tremors, dyspnœa, and general clonic spasms.

Isoamylamine.—This interesting ptomaïne has been discovered in yeast which has undergone putrefactive changes. It causes convulsions, rigors, and even death, being extremely poisonous. Isoamylamine is a colorless, strongly alkaline liquid, with a marked but inoffensive odor.

Patoammine.—The urine of persons suffering from progressive paralysis is said to generate this poisonous substance. It occasions spasms. Patoammine is also found in the urine of those with interstitial pneumonia.

Trimethylenediamine.—This substance has been found in the cultures of the comma bacillus, and it produces convulsions. Ferre obtained from the urine of persons suffering from epilepsy a base which occasioned spasms similar to those of strychnine. Griffeth also isolated such a substance, and Gerdes secured highly poisonous germs from the cadavers of women with puerperal eclampsia, which occasioned spasms.

Ethylidenediamine.—Brieger obtained such a substance from decaying fish. Its poisonous effects are severe. It causes dyspnœa and dilatation of the pupils.

Other poisonous ptomaïnes found during the process of putrefaction are *ethylendiamine* (found in cancerous stomachs), *tetanine*, *tetanotoxine*, and *spasmotoxine* (from tetanus bacillus cultures). All of these substances produce convulsions and are poisonous. *Mydatoxine*, obtained from decomposing human viscera, causes convulsions, dyspnœa, and looseness of the bowels.

Many processes have been advocated for obtaining these bodies, but the following method is usually resorted to: The decomposed material should be treated with acetic acid and alcohol for some days. It is then filtered several times, and the alcoholic extract reduced on a water-bath. The aqueous extract is concentrated to a sirupy consistence. This may now be used for experimentation on the lower animals. By treating this acid solution with chloroform, ether, or amylic alcohol, after it has been alkalized, the various ptomaïnes have been isolated.

EMBALMING FROM A MEDICO-LEGAL STAND-POINT.

The almost universal custom of using embalming or preservative fluids after death, for the purpose of preventing decomposition, by introducing antiseptic substances into the various spaces, blood-vessels, and organs of the internal parts, is a practice which calls for specific and strict statutory instructions.

If the body to be examined be embalmed, the greatest care must be exercised in the inspection of the various parts, as it frequently happens, in poison cases, that the changes produced by the embalming fluid are of such a nature as to preclude the possibility of determining the actual signs of death. The various structures with which the fluid comes in contact are so altered and changed, both in color and consistence, as to render the examination utterly worthless.

It is a well-known fact that arsenic and corrosive sublimate (but particularly the former) enter into the composition of most embalming fluids, and are indiscriminately used, so much so that they are frequently employed as a certain method of concealing crime. This possibility was first pointed out by Dr. Hay in 1876.

These preparations are commonly used by undertakers and others for the preparation of bodies for burial. The methods for performing the operation of embalming are various. Some undertakers place the entire body in a solution of arsenic, or simply cover it with cloths saturated with such a solution. Some inject the fluid into the mouth and rectum; others make numerous punctures through the abdominal walls with a trocar, and thus fill the cavity with the fluid; and still others inject the arsenic into an artery, or into all of the cavities of the body.

In addition to the changes occasioned by the contact of the embalming fluid with the tissues, the numerous punctures made, when the trocar is employed, may open abscess and other cavities, permitting collections and accumulations of various kinds, to the great annoyance of the toxicologist.

The following recipe is very often employed for preservative purposes:

℞ White arsenic	60	ounces,
Salts of tartar	32	ounces,
Carbolic acid (common black)	2	pints,
Glycerin	½	gallon,
Water	½	gallon.

M. These are allowed to simmer gently over a fire until the whole is in solution. A less quantity of water can be used if it is desired to preserve the body for some months. This fluid keeps for any length of time.

The possibility of the post-mortem diffusion of arsenic through the body has been proved by several investigators. The following experiments by Professor Vaughan, of Michigan University, demonstrate this fact beyond a doubt. About fifty grains (3.24 grammes) of arsenous oxide, suspended in cold water, were injected into the mouth and rectum of a dead musk-rat.

ch was then buried in the ground for a period of twenty-five days, after .ch it was disinterred and the various organs subjected to analysis, with following results:

Name of Part examined.	Amount of Arsenic, calculated as As_2O_3, found.
dneys	.00095 gramme.
ver	.01082 gramme.
ngs	.19252 gramme.
omach and contents	.00686 gramme.
rge intestine	.40339 gramme.
nall intestine	.19157 gramme.
eart	.02507 gramme.
rain	.03960 gramme.
Total As_2O_3 recovered	.78078 gramme.

As portions of the poison may find their way down into the lungs through ıe trachea, this may account for the larger proportion of arsenic found in he lungs than in the stomach in the above instance. As the liver likewise ontained more arsenic than the stomach, it is presumed that the poison assed thereto from the lungs.

The second experiment was performed on a cadaver. The person had een dead two or three days when the arsenic was introduced. The mouth nd rectum were used, as in the first experiment, as channels of entrance for the arsenic, of which an unweighed quantity suspended in cold water was injected. After the body had lain away in a dry place (cellar) for twenty-five days, the kidneys, liver, heart, stomach, spleen, etc., were removed, weighed, and analyzed, with the results exhibited in the following table:

Name of Part.	Weight of Part.	Weight of As_2O_3.	Per Cent.
Right kidney	104 grammes.	A distinct mirror.	....
Left kidney	90 grammes.	.00703	.00782
Liver	865 grammes.	.08316	.00961
Lower lobe of right lung	99 grammes.	.04333	.04376
Heart	370 grammes.	.02199	.00594
Transverse section of colon	85 grammes.	.02659	.03128
Rectum	22 grammes.	1.65000	7.50000
Spleen	48 grammes.	.00455	.00947
Stomach	300 grammes.	2.11200	.70405
Brain	1028 grammes.	.00363	.00030

These experiments prove that the post-mortem imbibition of arsenic, and its diffusion through the cadaver, are quite as thoroughly performed as they would have been had the body had life and had the poison caused death. They further demonstrate that the discovery of the poison in the various organs after death is no proof of its administration during the life of the person.[1]

[1] Journal of the American Medical Association, vol. i. p. 115.

It is an utter impossibility to distinguish ante-mortem from post-mortem arsenic. Dr. Pellew[1] says, "At the present moment it would seem that, if once the undertaker is allowed to enter the house, there is no chance of conviction in arsenic-poisoning. This means that arsenic, instead of being the most dangerous, is now, practically, the safest agent for committing murder. And also that, unless the attending physician is clever enough to risk his own professional career by calling in the authorities and insisting on an autopsy at once, there is practically no hope of conviction."

Again, unjust sentences may be passed upon innocent persons accused of committing murder by arsenical poisoning so long as the practice of using arsenic in embalming fluids continues. Laws should be enacted making it unlawful for any one to introduce into or upon any corpse, for the preservation of the same, any so-called embalming fluid or material which will in any manner interfere with the chemical tests which may subsequently be made use of by toxicologists in medico-legal investigations.

[1] Hamilton's System of Legal Medicine.

PART II

FORENSIC MEDICINE

time, exists in the several States with all the common-law *provisos*, unless the same have been modified by special statute, such, for example, as exists in the State of New York, and particularly in the city bearing the same name, where the statutory provisions alone regulate the powers and duties of these officers. The powers of coroners in the United States, as at present defined, emanate from the English Stat. de Officio Coronatoris, 4 Edward I., s. 2.

The duties of a coroner are both *ministerial* and *judicial*,—ministerial, as to become, *ex-officio*, sheriff when the office of the latter has been vacated; or to act as a substitute for the sheriff, as when the latter officer is a party himself. The duties, rights, and powers of the sheriff will devolve upon the coroner when he assumes these responsibilities. The *judicial* authority of the coroner relates to inquiries into the unknown or unexplained causes of sudden or violent death, by a jury of inquest, *super visum corporis*. He can compel the attendance of witnesses, and at the inquest he is fortified with all of the ordinary power of a judicial officer. The common law gives him authority to compel obedience to his subpœnas. The authority to hold inquests extends beyond the territorial jurisdiction of the coroner. For example, an individual dies in one county and is buried in another, and if, on account of the suspicious nature of the death, an inquest becomes necessary, the coroner of the latter county is the proper officer to conduct the proceedings. Besides these duties, the coroner is also invested with the further power to inquire of other felonies, of treasure-trove, and of wrecks. In the United States the coroner is elected for a term of several years, but in England he is appointed for life, subject to removal for cause by the writ *de coronatore exonerando*. The common law does not permit of the appointment of a deputy coroner, though most States in the Union have established statutory provisions whereby the coroner has the power to make such appointments. Coroners are excused from serving in offices which might interfere with their duties of coroner, and are further privileged from serving on juries, and from arrest when employed in their official duties. On the other hand, they are liable to punishment for wilful neglect of duty and for wilful misconduct in the execution of their office; in fact, they may be indicted. At any rate, they make themselves liable to a criminal information for any misconduct in taking an inquisition.

The Coroner's Court and the Inquisition.—This is a court of record, of which the coroner is the presiding judge. He enjoys all the privileges which are accorded judicial officers, and he is further protected from any responsibility in a civil action that might be brought by a private person.

Whenever a coroner receives notice that any person has been slain, has suddenly died, been dangerously wounded, or found dead under such circumstances as to require an inquisition, he is legally bound to proceed to the place where the body has been found, and to forthwith summon a jury, to the number required by the statute law of his State, to appear before him at such place as he shall appoint. Those selected by the coroner as jurors

are bound to appear, and should be *probi et legales hominis*. Their selection should be carefully made. Jurors are not liable to challenge, as is the case in criminal courts. Their duties are to investigate and determine the facts of the case. They must view and examine the body of the deceased together, and not separately; and they must establish, if possible, the identity of the dead person. After the jury has viewed the dead body, they retire to some convenient locality for the purpose of hearing the testimony of witnesses and the post-mortem report of the physician or surgeon delegated by the coroner for the inspection of the deceased. After the recital of the testimony, the jury consult together, and after reaching a conclusion, which is usually in accordance with the report of the coroner's physician, they deliver to the coroner, in writing, their inquisition. "An inquisition, properly speaking, is the written statement of the verdict of the jury, returned for the purpose of particular inquiry, as distinguished from an indictment. Where it contains the subject-matter of accusation, it is equivalent to the finding of a grand jury, and the parties may be tried and convicted upon it. The caption is a necessary and essential part, and should be drawn up with precision, and contain the name of the county. The time and place when and where holden must appear with certainty; also, that it was taken before a court of competent jurisdiction. The name of the deceased must be set out, if known; also, where the body lies; also, that it was taken by the oaths of the within-named jurors, and it must expressly appear that the jurors are from the county or jurisdiction, and that they present the inquisition upon oaths. The verdict must be stated with legal precision and certainty, and the charge must be direct and positive. The attestation is an essential part of the inquisition." [1]

One inquisition may be sufficient in cases where several persons were killed by the same cause, as, for example, where wholesale death results from a sudden explosion, etc. On the other hand, the coroner may hold an inquest on each separate body, he being the sole judge of the necessity of such proceeding.

If upon the inquest any one is found guilty of a crime, the coroner has the power to issue a warrant for the arrest of the suspected person, and if captured he is to be committed to prison by the coroner, and the inquisition with the evidence forwarded to the proper authorities.

Massachusetts's Statutory Provision.—The office of coroner was abolished in Massachusetts about eighteen years ago, having been supplanted by a system which provides an officer for medical examination, and requires him by the terms of the law to be "an able and discreet man, learned in the science of medicine." The law invests the governor with the power to make these appointments, with the advice and consent of the council. Under this system the medical and judicial functions are separate and distinctly defined. The medical officer is authorized to take charge of all au-

[1] American and English Encyclopædia of Law, vol. iv.

topsies and medical questions in inquiries, and if, on examining a dead body, and after personal inquiry into the cause and manner of death, he deems further examination necessary, he shall, on the written authorization of the district attorney or other competent judicial authority, proceed in a careful way to make an autopsy in the presence of at least two discreet persons. He is further required to then and there reduce to writing every circumstance and fact tending to show the condition of the body and the cause and manner of death, together with the names and addresses of the witnesses, and forward them at once to the district attorney or the nearest trial justice. An inquest is then held by the latter to determine, if possible, who is responsible for the death in question. The inquest may be conducted privately or not, just as the justice sees fit, and he may keep witnesses apart; he has the same powers conferred on him as in other cases. The *standing* of the medical examiner at the inquest is on a plane with that of other witnesses, his authority having ended with the post-mortem examination and the delivery of the body to the undertaker for burial.

New York's Statutory Provision.—As stated heretofore, the powers and duties of coroners are regulated by statute. For the State at large it is provided that four coroners be elected in each county, each for a period of three years. They are not required to furnish bonds, except when acting as sheriffs, when they may be required to do so.

The duties of these officers in this State are to inquire into all cases of sudden or violent death. They are authorized to arrest those who disturb religious meetings; to take charge of wrecks and wrecked property, and to take measures for the preservation thereof and for its delivery to the proper owners. They also have the power to investigate the origin of fires, by an inspection and inquest with a jury, with proceedings in most respects like the inquests in cases of sudden death, with authority to arrest in case there is found to have been arson committed or an attempt at arson.

In case of the absence or inability of the coroner to act, in the city of New York any alderman or special justice may act instead, exercising the same duties and powers as the coroner. The coroner usually has the power to appoint one or more physicians as assistants, or deputies, known as coroner's physicians. These officers have the power to make all the medico-legal investigations.

According to the New York Criminal Code, "a coroner is disqualified from acting as such in any case where the person killed or dangerously wounded is a co-employee with the coroner of any person or persons, association or corporation, or where it appears that the killing or wounding has been occasioned, directly or indirectly, by the employer of the coroner. . . . The defendant against whom an inquisition has been found by a coroner's jury is entitled to a hearing before a magistrate, whether he has been arrested before the inquisition has been filed, or is arrested after such filing."

The Criminal Court.—After the inquisition held by the coroner's jury in a criminal case where the suspected person has been committed for trial,

a preliminary examination is held by the grand jury, who either find *a true bill* or *ignore* the case altogether. In the latter event the whole matter is dropped and the prisoner discharged from custody. If, however, a true bill has been found, the case comes up before the judge and petit jury for trial as to the guilt or innocence of the suspected individual. To this trial the medical witness is likely to be summoned to appear by a subpœna, which is an imperative order that cannot be slighted. Here it is that his professional knowledge, experience, and acquirements will be thoroughly ventilated in the cross-examination, requiring all his thought and acumen to offset the otherwise certain annoyance and confusion that invariably follow such inquisitions. Therefore, the following advice by the late Dr. Taylor, if followed, will place the physician-witness upon such a plane that he need have no hesitancy or fear in testifying. "First, he should be thoroughly prepared on all points of the subject on which he is to give evidence; and, secondly, his demeanor should be that of an educated gentleman and suited to the serious occasion on which he appears."

Evidence (*Medical*).—Following the opening of a case in court, the district attorney or one of his representatives proceeds to examine the different witnesses according to the rules of evidence. This is called the *examination-in-chief*, because the witness recites the actual evidence in support of the side on which he has been subpœnaed. Leading questions that suggest their answers are not allowed, though certain allowances are permissible in cases where witnesses have an object in concealing important evidence which is essential in establishing the guilt of an accused party. Such persons are called "hostile witnesses." In connection with this part of the subject there are certain questions which frequently arise that require notice here. (1) *As to written notes:* These are only admissible in court that the witness may refresh his memory, and not to supply its place. They are not admissible if they were made after the occurrence to which they relate, and they must be original and not copies. According to Tidy, "the actual notes taken at the time of, or, at most, immediately after, the occurrence to which they relate—uncorrected, unexplained, uninterpolated—are *the* notes to be used, and no other." (2) Expert witnesses frequently feel inclined to quote authorities in the witness-box. This, as a general rule, is inadmissible evidence, because the scientific witness is merely called upon to express his own opinion, and not to corroborate it by reading similar opinions from standard medical works. But in England and in some of the United States *counsel* are permitted to lay before the court readings from recognized scientific books as a part of their argument. These works may be read in evidence to contradict a witness who has testified concerning statements alleged by him to be contained in the book.[1] This *permission* is not allowable in all States, but is left to the discretion of the court. (3) *As to medical secrets:* In some instances the court may compel a medical man to divulge secrets;

[1] American and English Encyclopædia of Law, vol. xv.

but in England no special privilege is granted medical men with regard to professional secrets. In the State of New York "no person duly authorized to practise physic or surgery shall be allowed or compelled to disclose information which he may have acquired in attending any patient in his professional character, and which information was necessary to enable him to prescribe for such patient as a physician, or to do any act for him as a surgeon."

The *cross-examination* is conducted by the counsel for the prisoner. Its special aim is to break down the testimony of the witness, leading questions being the method of attack. Great latitude is allowed to counsel in the cross-examination of a hostile witness, his duty being to expose omissions and inconsistencies in the previous testimony of the witness.

In *re-examination*, which sometimes follows the cross-examination, the object of the counsel for witness's side is to clear up matters that may have been rendered obscure by the opposing counsel's examination. Counsel cannot bring up any new matter except by special consent of the court, the rule being that he must confine himself to the subjects about which the witness was cross-examined. In some instances the presiding judge may ask the witness certain questions bearing upon the case.

Ordinary and Expert Witnesses.—The difference between an *ordinary* and an *expert* witness is this: the former testifies only to facts which have come within his personal knowledge, while the expert or skilled witness gives an opinion on the facts observed by himself or proved in evidence by others. "The medical expert, when placed on the witness-stand, is called upon not only to state medical facts, but also to express an opinion on the special facts of the case under examination. He may be examined as to conclusions of science drawn from particular experiments; he may be questioned as to the health of a particular person whom he attended; he may be asked his opinion as to the probable cause of the death of a person; he may testify as to the presence of poison in the stomach, and generally give an opinion on medical facts as observed by himself, or on facts observed by other persons and given in evidence." [1]

Among the rights of an expert is his *compensation*. Every medical man is bound to obey the subpœna which compels his attendance in court, but that he is bound to act as an expert witness without other compensation than the ordinary witness fee has not been definitely settled. Reese uses the following language concerning this matter: "As regards the obligation of a witness to obey subpœnas when he is to be questioned only as to his *opinion*, we think that in this country the mandate of the court is obligatory; the witness's duty is to obey it, and then, if not previously, endeavor to arrange about his compensation before giving his evidence."

This whole matter of expert testimony has been placed before the general public as being of little value, because when employed on both sides of any

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[1] Encyclopædia of Law, vol. xv.

se it is conflicting and anything but convincing. So, too, has the atten-on of the ablest minds of both lawyers and physicians been turned toward e abuse of this method of testimony. The only true and proper system ould be for the State to appoint one or more experts at an adequate salary, be known as State officers, for, as Dr. Reid[1] states, "it is exceedingly njust that any physician, whether willing or not, may, at any moment the w sees fit to specify, be required to go on the witness-stand in the character f a medico-legal expert. In that place, unless he be well posted in forensic edicine and possess the coolness and self-reliance required to repel the nslaught of the lawyers, his reputation for knowledge and skill may receive n twenty minutes injuries that cannot be repaired in a lifetime."

Dying Declarations.—To be admissible, death-bed confessions or dec-arations must be made when the party is at the point of death,—that is, hen every hope of recovery is gone. These declarations are admissible as vidence as soon as death has taken place.

"In consideration of the fact that the mental and physical conditions of he person at the point of death are usually such as to render the reliability f his statement extremely doubtful, no matter how conscientious he may be, here is no time when justice more imperatively demands the presence and id of an intelligent, experienced physician than when the law is endeavoring o fasten the crime of homicide upon a prisoner through the identification and dying declaration of the victim of deadly assault or of foul play. As in many instances the fate of the prisoner rests mainly upon such evidence, no means should be left untried which will assist in determining its credibility. The nature of many agents used to destroy life, and of injuries which result fatally, can be alleged as sufficient reason why, when it is necessary to bring the accused into the presence of the injured person to be identified, the State should, if possible, have a physician present, whose duty should be to make a careful examination of the declarant's mental, visual, and other con-ditions; for, at the time that the declarant may be trying to identify the prisoner, his intellect and vision may be so disturbed by cerebral anæmia resulting from the loss of blood as to lead to the gravest mistakes. Also, because the insidious intellectual changes which are sometimes the sequence of cranial injury may convert the best friends into the bitterest foes, and yet be undetected by inexperienced persons, though they would be suspected by the physician from the nature of the injury. Another fact likely to be unknown to a large majority of the laity is that, in anæmia resulting from loss of blood, the upright or semi-recumbent position may render the declarant less capable of making a trustworthy statement; whereas, the horizontal position, by encouraging the flow of blood to the brain, would increase mental activity, and thus tend to promote the ends of justice. The effects of the kind and quantity of stimulants given so freely at such times should also be noticed, as these not only vary greatly in different persons,

[1] Journal of the American Medical Association, vol. x. No. xxiii.

but vary greatly at the different periods at which they are administered to the same person. Where a woman is dying of septicæmia consequent upon criminal abortion, there may be slight delirium, or such form as occurs at intervals, which might slightly confuse the memory and distort the imagination, yet not be discovered by persons unfamiliar with the concomitant symptoms and pathological conditions present." [1]

CHAPTER XVIII.

PHENOMENA AND SIGNS OF DEATH.

Definition of Death—Molecular and Somatic Death—The Causes of Death—Characteristic Post-Mortem Evidences of the Varieties of Death—The Signs of Death: Cessation of Circulation and Respiration—Changes in the Eyes—Insensibility and Loss of Power to move.

WHEN the vital phenomena of living organized bodies cease to present themselves, we have death, or a cessation of life. The term of existence that nature has fixed is seldom reached; death by violence or disease is the rule; that from old age, the gradual wearing out of the human mechanism, the exception.

By *molecular death*, which may be either partial or complete, is to be understood the death of a part, organ, or tissue,—the incessant disintegration of tissue which occurs without the general stoppage of the circulation, the active processes of life being manifest. Complete molecular death, which is the true scientific death of the body, is progressive until the vital activity of every part of the organism is destroyed. *Somatic death* is the death of the body as a whole,—that is, the entire cessation of all the vital functions of the organism. The time when it takes place can be generally recognizable by the stoppage of the circulation and respiration. This is not the case when complete molecular death occurs. Some degree of molecular life may continue after somatic death, as is manifested by post-mortem caloricity and muscular irritability, by the post-mortem action of the heart, by epidermic fecundity, such as a growth of the nails and hair, and occasionally by evidences of nutrition and secretion. Somatic death is the universally popular idea of dissolution.

When death is sudden, the *immediate* or *actual cause* is referable to one or other of the three great centres of life,—the heart, the lungs, and the brain. These three *centres*, being the fundamental basis upon which animal existence is erected, were metaphorically called by the ancients the "tripod of life." The functions of this *tripod* are so intimately related that when one ceases to work the actions of the others are speedily inhibited, as each

[1] Journal of the American Medical Association, E. M. Reid, M.D., p. 706.

f these organs is absolutely essential to life. The following tabular view f the modes of sudden death is after Bichat's classification,—viz., (1) death eginning at the brain, *coma;* (2) death beginning at the heart, *syncope;* nd (3) death beginning at the lungs, *asphyxia*, or *apnœa*.

Tabular View of the Modes of Death.

COMA.

(*Death beginning at the Brain.*)

Causes.—Cerebral compression; apoplexy; fractures of the cranial bones; injury of the skull; hydrocephalus; blows on the head causing cerebral disturbance; the action of poisons, such as the narcotics (opium, etc.), or the minerals (arsenic, etc.); various discharges and hemorrhages; certain diseases of the liver and kidney (uræmic poisoning, etc.), etc.

Symptoms.—More or less profound stupor; insensibility to external impressions; loss of consciousness; slow, stertorous, and irregular breathing; power of voluntary control over respiration is lost, the latter becoming more and more feeble as the medulla begins to be affected; the blood is no longer aërated; the pulmonary circulation is stopped; the pulsations of the heart are arrested, and the lungs cease to move; the pupils are sluggish, and often dilated.

Post-Mortem Appearances.—Congestion of the membranes and substance of the brain and lungs, more or less blood being found in the cavities of the heart, especially in the right, though they are not so engorged as after death from asphyxia. (It is well to recollect that the appearances in the thorax after death in coma may be very slightly different from those occasioned by death in asphyxia.)

SYNCOPE.

(*Death beginning at the Heart.*)

Causes.—The arrest of the heart's action may be due to two distinct causes: (1) *Anæmia*, or a deficiency in the normal quantity of blood, which may be occasioned by a sudden loss of blood, as in rupture of an aneurism, or by hemorrhages from the uterus and lungs, and from injuries to the heart or larger blood-vessels. Extensive suppurations, etc., which indirectly drain the blood, are also etiological factors. (2) *Asthenia*, or a deficiency in the heart's power, on account of paralysis of its muscular walls. This may be brought about by various cardiac diseases (fatty degeneration, etc.), starvation, exhausting diseases (phthisis, cancer, diabetes, dysentery, cholera, etc.), certain poisons (digitalis, prussic acid, etc.), certain injuries (blows on the epigastrium, concussions of the spine, etc.), and severe brain-lesions.

Symptoms.—(1) *Anæmia.*—A mortal paleness or duskiness of the face; lividity of the lips; cold perspiration; dimness of vision; tinnitus aurium; vertigo; fluttering and weak pulse; dilated pupils; gradual insensibility. Other symptoms that may occur are nausea or vomiting; jactitations; irregular breathing; transient delirium; photophobia; convulsions before death. There is frequently hiccough. The nervous symptoms are due to the deficient supply of blood to the brain. Sometimes the nervous system is primarily affected in consequence of this want of blood. (2) *Asthenia.*—Lividity of the fingers, lips, nose, and ears, on account of the arrest of the circulation in the extremities. The general surface, also the hands and feet, become cold; there is extreme muscular weakness; the pulse is weak and frequent; the senses and the intellect are unimpaired to the last. This condition is also seen in the collapse of Asiatic cholera.

Post-Mortem Appearances.—(1) *Anæmia.*—In death from anæmia the heart is found to be in an empty and contracted state, the organ being arrested on account of deficient blood-supply. If life has been somewhat lengthened, a heart-clot may be detected. The tissues and various organs are usually of a pale color. (2) *Asthenia.*—In asthenia the blood is found in the large arteries and veins, and, on account of this stoppage of the fluid in its course, the cavity of the heart is more or less dilated or flabby, though it may contain some blood. There is no engorgement of the brain or lungs.

APNŒA.

(Death beginning at the Lungs.)

Causes.—Respiration may be arrested (1) by any mechanical obstruction to the ingress of air into the lungs, as tetanic spasm of the respiratory muscles (strychnine-poisoning, tetanus); pressure of the thorax; exhaustion of the muscles from debility or cold; foreign bodies in the air-passages; paralysis of the pneumogastric or phrenic nerves; submersion; suffocation, hanging, strangulation; absence of air, as in very high altitudes; certain irritant gases (sulphuretted hydrogen gas, chlorine, etc.). (2) By diseases, such as those of the lungs (bronchitis, pneumonia, etc.); spasm of the glottis; œdema of the glottis; embolism of the pulmonary artery; pharyngeal abscess; and the accumulation in the pleural cavities of serum, blood, or pus.

Symptoms.—Sense of suffocation, with an intense struggle to breathe; lividity of the face; loss of consciousness; vertigo; relaxation of the sphincter muscles; and general convulsions.

Post-Mortem Appearances.—These are engorgement of the pulmonary artery, the right cavities of the heart, and the venæ cavæ; the viscera are commonly engorged, while the left side of the heart, the aorta, and the pulmonary veins are found comparatively empty. In some instances, however, the cavities of the right side of the heart are empty. The lungs may be engorged with dark blood.

In order to be able to determine, at the least, the approximate cause of death, the medical examiner should be familiar with the foregoing varieties of somatic death, and keep in mind the post-mortem appearances attendant on each variety. The immediate cause of death is to be looked for in the brain, heart, or lungs, no matter what the remote cause may be. Occasionally, however, it happens that the cause of death cannot be determined, such as when a sudden stoppage of the heart through reflex nervous inhibition occurs, as is seen in those suffering from violent emotion, etc. Post-mortem lesions are rarely found to exist in such cases. In other cases the causes are many. Thus, the nervous system will feel the effects of injuries to the heart or lungs, and, *vice versa*, the circulatory system will be affected if the proper nerve-energy is found wanting, or the heart-action will fail to respond properly if the respiratory system is in an abnormal state. This combination of causes may make it extremely difficult or impossible for the examiner to state which cause was foremost in contributing to the fatal result. This interdependence existing between the nervous, circulatory, and respiratory systems is not always uniform in degree; death beginning at the lungs or at the heart is of more rapid occurrence than when it begins at the brain. The latter is the centre of the organism, while the other two are

chief means of maintaining the organic functions. When disease or ence arrests the action of the brain and causes a cessation of the func- s of sensation, thought, and action, the organic functions of respiration circulation may still continue, as in apoplexy, where the patient falls seless and motionless, while the heart and lungs continue to operate.

A matter of great medico-legal importance is that which comprises the nomena and signs of death. That the reality of death can be determined certain signs cannot be denied, although exceptional cases crop up where corpse retains all of the natural appearances usually observed previous inal dissolution. It becomes, therefore, a matter of great importance for medical examiner to be familiar with all the signs which are the precise ications of death.

Other questions of medico-legal import that arise at every inquest over a pse are *the cause of death*, and, secondly, *the time that has elapsed since has been extinct.*

The horror of being buried alive naturally suggests the great importance being familiar with the signs of death. Professor Nussbaum, of Munich, es full scope to his credulity, and states, without hesitation, that during war between France and Germany many soldiers were buried alive. se persons, he claims, were merely suffering from an extreme lethargy asioned by excessive hemorrhage, exhaustion, hunger, etc. However might be, there are but few well-authenticated cases of premature burial. e it is that sounds have been heard, disarrangement of the coverings of dead noticed, bodies frequently found turned in their caskets, etc., but hese effects are due entirely to other causes, they are readily explained. gases generated in the body by its corruption simulate in their action n a corpse many of the movements of vitality. The bodies of persons have been submerged in the water for a long time have been known to heaved up and even thrown upon the ground from the effects of the eous products of decomposition. The sounds that have occasionally been rd, the change in position of the body, and so on, are undoubtedly due he gases already referred to.

The signs of death, to be of value in determining the absence of life, st be considered collectively, and not singly.

THE SIGNS OF DEATH.

I. Cessation of Respiration and Absence of Audible Heart- ats.—The suspension of these functions has been observed in cases of parent death, as in catalepsy or lethargy, syncope, trance, etc. This est of the functions of respiration and circulation is not absolute ; for were so, death would rapidly follow. It is well known that certain of the lower imals—the marmot, for example—pass into a state of hibernation during e winter season, being to all outward appearances dead. According the experiments of M. Bouchut, the beats of the heart in the marmot ere reduced from a range of eighty to ninety per minute during its state of

activity to eight or nine in the state of hibernation. Cases are recorded in which human beings could suspend the action of the heart, so that no movement, such as pulsation, could be noticed. Colonel Townsend, as reported by Cheyne, had the power of retarding the action of his heart, so much so that no heart-action was discernible. He was apparently dead, and remained in that state for half an hour. Braid mentions instances where Indian fakirs were able to pass into a state of trance by holding their breath, during which time the absence of audible heart-sounds was noticed. Loomis[1] says that these phenomena have been observed in the new-born child.

These instances, however, are of rare occurrence, and contrary to all physiological experience, for life cannot continue long without the circulation of the blood and the exercise of the function of respiration. Nevertheless, it is well to remember that the heart often beats so slowly and infrequently, and the movements of respiration are so slight, that the greatest care must be taken to determine whether the person is really alive. Duval mentions an interesting case where the heart of a criminal pulsated fifteen minutes after decapitation, the left auricle continuing to beat more or less for an hour.

To be positively certain of death, the examiner must convince himself not only of the entire cessation but of the continuous cessation of the action of the heart and the arrest of the function of respiration.

Tests.—(1) The region of the heart should be carefully examined with the stethoscope, recollecting that the position and sounds of the heart might be abnormal. (2) A good test is to apply a ligature to a finger, limb of the body, etc., and note the change, if any is produced; if the person be alive, the part beyond the constriction will become a deep-red or purple color, on account of the arrest of the circulation at that point. (3) If a scarificator and a cupping-glass be applied to a dead body, no blood flows, although cases are recorded where blood has escaped as many as eight days after death from certain wounds inflicted during life. (Levasseur.) (4) If a clean, bright needle be thrust into a muscle, such as the biceps, and left there, it will rust and tarnish (oxidize) rapidly if life be present. After death there is no such change. (*Cloquet's needle test.*) (5) The opening of a vein, to note whether coagulation has occurred or not. (6) As moisture is a constant constituent of the breath, the application of a looking-glass over the mouth and nose renders perceptible the slightest trace of moisture as it condenses upon the glass. (7) The suspension of a feather or other light body near the mouth or nose may be regarded as a sign of death when it remains unmoved.

II. **Changes in the Eyes.**—The following changes occur in the eyes after death: (1) The loss of sensibility of the eyes to light, there being absolutely no contraction nor expansion of the pupils. Certain poisons, however, act upon the eyes in a similar manner, as is also the case in some of the affec-

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. i. 1894.

tions of the brain. (2) The loss of sensibility of the cornea to touch is always found to exist after death, although it occurs in certain injuries of the brain, etc. (3) The loss of transparency of the cornea, and the loss of tonicity and of the elastic resistance of the eyeball occur speedily after dissolution, although these conditions may exist before death. Cases are recorded where the former condition was observed several hours before death in cholera. On the other hand, the cornea may not lose its transparency for a considerable length of time after fatal consequences, as has been noted after death from apoplexy, poisoning by the oxides of carbon, etc. (4) The conjunctivæ present changes soon after death, and the eyelids lose their tonicity and elasticity. Gray, cloudy discolorations, rapidly changing to black (due to films of mucus, or to putrefactive changes), are observed upon the conjunctivæ, and, according to M. Larcher, are soon followed by similar changes upon their internal surfaces.

III. **Insensibility and Loss of Power to move.**—This condition may occur without resulting in death, as is well seen in asphyxia, apoplexy, catalepsy, syncope, etc.

CHAPTER XIX.

SIGNS OF DEATH—*Continued.*

Pallor of the Body—Loss of Animal Heat—Rigor Mortis (Cadaveric Rigidity)—Cadaveric Lividity (Suggillation)—Putrefaction—Saponification (Adipocere)—Mummification—Subsequent Remarks.

IV. **Pallor of the Body.**—After death a peculiar ashy pallor usually spreads over the entire body. This is not a characteristic sign of death, however, since there are some exceptions, as in death from yellow fever, etc., and also in persons who have a ruddy complexion, where the lips and cheeks retain their natural high color for some time after dissolution. The red or livid rings around ulcers and burns, the spots of purpura hemorrhagica, tattoo marks, and ecchymoses and bruises do not disappear. Moreover, a death-like pallor frequently occurs in cases of fainting, the cold stage of ague, and occasionally in collapse.

V. **Loss of Animal Heat.**—During life the healthy animal body has the power of maintaining its own temperature of about 36.7° C. (98° F.), notwithstanding the character of the surrounding medium. This source of heat is derived in the potential energy admitted into the body with food, and with the oxygen during the process of respiration; but the direct sources are contained in the blood during digestion, when it becomes saturated with more carbon, oxygen, and hydrogen than are needful for tissue repair; these gases by their combination with the sulphates generate heat by chemical means, the rest of the body heat being slowly developed by a

slower combustion. Heat is also generated by the brain, muscles, and glands. When these vital processes cease, as they do after death, there is a gradual and progressive lowering of the temperature of the body, until it attains that of the atmosphere surrounding it. For the period of three hours after dissolution the loss of body heat per hour may be stated at about three and a half degrees, after which it gradually falls at the rate of a degree and a half each hour. This loss continues on the average for fifteen to twenty-four hours, when the temperature of the atmosphere is reached. The medico-legal importance of this cooling process after death is that the loss of heat is *progressive*, thus aiding in the determination of the time that a body has been dead.

The post-mortem loss of heat never falls below that of the atmosphere unless the temperature of the latter becomes suddenly increased. When making observations on post-mortem temperature, the use of the thermometer is indicated, as the sense of touch is not sufficiently delicate for noting the actual coldness of the body. The external and internal temperature of the body should be recorded, the former being taken in the axilla and the latter in the mouth or rectum. If the temperature taken in the oral cavity is lower than that of the surrounding medium, it is a good sign of death, but the fact must not be lost sight of that there are certain conditions which influence the rate at which the body turns cold. Thus, the time of cooling may be modified by the condition of the body at the moment of death, by the manner of death, and by various other circumstances, as where the corpse has been freely exposed to the air, etc., thus hastening the cooling process, or, in the case of certain diseases, retarding it.

Thin and emaciated bodies lose heat more rapidly than fat bodies; the bodies of old persons and children become cold quicker than those of persons of middle age; while those who are killed by suffocation or electricity (lightning) lose their heat less rapidly. Other circumstances that prolong the cooling of the body after death are: (1) the body being clothed; (2) if kept in a small and close room; and (3) its being covered, or kept on non-conducting material.

Causes of rapid cooling are: (1) its exposure to a good conducting surface; (2) death from immersion in water; and (3) its exposure to currents of cold air, etc.

The heat of the interior of the body is retained much longer than that of the external surface, the viscera frequently being twenty degrees or more above that of the surface.

In some instances the temperature of the dead body rises instead of falls; this is observable in the bodies of persons who have succumbed to the effects of yellow fever, rheumatism, chorea, cholera, small-pox, tetanus, etc., where the temperature has reached 40° C. (104° F.), and even 44.4° C. (112° F.), as recorded by Davy in the pericardium. This singular phenomenon may be occasioned by the continuation of molecular life after the cessation of somatic.

The following table of the time occupied for post-mortem cooling is taken from Tidy's "Legal Medicine," vol. i., the observations being those of Drs. Taylor and Wilks. (The external temperatures were taken by the application of the thermometer to the skin of the abdomen.)

Period after Death.	Two to Three Hours.		Four to Six Hours.		Six to Eight Hours.		Twelve Hours or more.	
Number of Observations	76		49		29		35	
Scales	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.
Maximum temperature of body	94	34.4	86	30	80	26.6	79	26.1
Minimum temperature of body	60	15.5	62	16.6	60	15.5	56	13.3
Average temperature	77	25	74	23.3	70	21.1	69	20.5

Niderkorn's observations on *external* temperatures, taken in the axilla, are shown in the following table, being the average results of one hundred and thirty-five observations.[1]

Temperature of Body after Death.	Two to Four Hours.		Four to Six Hours.		Six to Eight Hours.		Eight to Twelve Hours or more.	
Scales	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.	Fahr.	Cent.
Maximum	109.4	43	98.2	36.8	95.3	35.2	100.4	37.8
Minimum	89.6	32	80.6	27	70.5	21.6	62.6	17
Average	96.9	36.1	90.2	32.3	81.7	27.6	77.9	25.5

In the subjoined table of Goodhart[1] the rapidity of the post-mortem cooling during the first few hours after dissolution, compared with that which takes place at later periods, is recorded.

Time after Death.	Three Hours. Loss per Hour. Degrees Fahr.	Six Hours. Loss per Hour. Degrees Fahr.	Loss per Hour. Body nearly Cold. Degrees Fahr.
In the emaciated	4.7	3	1.12
In the robust	3.5	3	1.26

The observations of Taylor and Wilks on *internal* temperatures after death show 24.45° C. (76° F.) seventeen and eighteen hours after death, and 29.45° C. (85° F.) ten hours after death.

VI. **Rigor Mortis.**—Rigor mortis or cadaveric rigidity is the stiffening of the muscles throughout the body after death, which generally takes place within six hours after that event. It lasts for from sixteen to twenty-four hours, or until putrefaction sets in. Rigor mortis is probably occasioned

[1] Tidy's Legal Medicine, vol. i.

by the coagulation of the myosin in the muscles, an albuminous principle of muscular tissue.

After the stiffness of the muscles and joints passes off the corpse regains its original pliancy, which is probably due to the dissolving of the myosin when putrefaction occurs. An important fact of medico-legal interest is that during the stage of rigor mortis the muscles retain the position they assumed at the time when the stiffening began; in other words, a flexed limb remains in that state until it is overcome by external force, as in bending a leg. If a limb is bent after being flexed, it never regains its rigidity unless the rigor mortis is incomplete.

The order in which rigor mortis occurs is a very definite one. It occurs first in the muscles of the eye; next in the muscles of the lower jaw and neck; then the chest and upper extremities; and, finally, the muscles of the abdomen and lower extremities. The rigidity generally disappears in the same sequence.

Rigor mortis is the rule in death from any cause, and its supervention and duration depend upon the previous degree of exhaustion. Thus, in death from phthisis or other exhausting diseases, it manifests itself early (in a case of death from typhoid fever, recorded by Brown-Séquard, it set in three minutes after the patient ceased to breathe); whereas, in those dying suddenly from accidental causes while in perfect health, it is protracted for some hours, sometimes for as long a time as twelve hours, or even more. An important fact to recollect is that heat shortens and cold prolongs the rigor mortis.

As already observed, the duration of cadaveric rigidity is extremely variable, averaging from sixteen to twenty-four hours; although in some cases, such as death by lightning or electrocution, it occurs within a few hours, while in other cases it has lasted for seven and fourteen days. (Loomis.)

Rigor mortis should not be confounded with *cadaveric spasm*, which is closely connected with it. The latter occurs in persons who have died sudden or violent deaths, such as by suicide, etc. Reese, in his "Medical Jurisprudence," etc., says that "the best illustrations of this peculiar condition are afforded in those cases of determined suicides who have taken their lives by shooting themselves with a pistol. Very commonly, in such cases, the lethal weapon is found so tightly grasped in the dead man's hand as to require considerable force to remove it. The same thing is witnessed in the bodies of drowned persons,—fragments of wood, grass and weeds, or other objects which had been convulsively seized in the water before death, being found tightly grasped in the hands; and where two persons have perished together by drowning, it is not uncommon to find them, after death, convulsively clasped in each other's arms. To a similar reason, doubtless, is to be ascribed the singular and striking posture which bodies of soldiers on a field of battle, killed in conflict, are noticed to have assumed in the act of dying."

VII. **Cadaveric Lividity.**—Cadaveric lividity, cadaveric ecchymosis or hypostasis, is the result of the gravitation of the blood in the capillaries

which occasions those livid or violet-colored patches or discolorations which are observed upon the body within a few hours after death. It is presented in diffused patches of very great extent on the back part of the trunk, head, extremities, face, ears, and neck, but is not fully developed until the body has cooled, when it is arrested. These patches are at first isolated, and often mottled in interspaces, but they soon become coalesced. Upon section of the skin being made, the color is found to be confined to the upper layer of the true skin, or in the interspace of cuticle and cutis. The color deepens immediately before putrefaction sets in, the change being probably due to an infiltration of pigment, derived from the blood, into the dependent portions of the body.

Internal lividities occur at the same time that the external discolorations are taking place, and, like them, they settle in the most dependent parts of the several viscera,—a fact of forensic importance in determining whether the congestion be due to some disease, or to the lividity occurring after death. Internal hypostasis is most marked in the veins of the pia mater and the posterior hemisphere of the cerebrum, the posterior part of the spinal cord, the posterior part of the lungs, and the most dependent portions of the intestines, stomach, and kidneys.

Cadaveric hypostasis of the brain may be mistaken for congestive apoplexy; this condition in the spinal cord for pre-existing meningitis, or for the sequelæ of injuries to the back inflicted during life; in the lungs it may be confounded with pulmonary apoplexy or the first stage of lobar pneumonia; and in the intestines it may be mistaken for the effects of inflammation. The position of these lividities should aid the medical jurist in avoiding possible error in this connection.

The following table[1] shows the chief points of difference between a vital ecchymosis and a post-mortem ecchymosis:

VITAL ECCHYMOSIS (BRUISE).	POST-MORTEM ECCHYMOSIS.
Anatomical Seat.	*Anatomical Seat.*
Effusion of blood into the true skin and subcutaneous tissue.	Congested capillaries in the rete mucosum and vascular tissue above the true skin.
Situation.	*Situation.*
At the seat of the injury, the deeper tissues being generally discolored.	Such dependent portions of the body as are not subjected to pressure. The superficial layers of the true skin are principally involved.
Appearance.	*Appearance.*
The mark of the instrument that inflicted the injury is often perceived on the bruise. The color of the latter is not generally uniform. The injured part is frequently elevated above the adjacent skin.	The post-mortem lividity is irregular in shape, the edges, however, being well defined. The color is dark throughout, and there is no elevation above the surrounding skin.

[1] After Tidy.

VITAL ECCHYMOSIS (BRUISE)—*Continued.*	POST-MORTEM ECCHYMOSIS—*Con*
Extent.	*Extent.*
Generally limited in area to the parts injured.	Very extensive.
Results of Incision.	*Results of Incision.*
Either a flow of effused blood, or else a coagulum will be observed.	There is no escape of effused agulated blood, although there apparent a few bloody specks or arising from the division of small the skin.
Changes by Age.	*Changes by Age.*
Change of color occurs after eighteen or twenty hours (sometimes two or three days), the dark purple bruise becoming highly tinted at the margins, being of a more or less violet color. The color then passes to green and yellow, the centre always remaining the darkest part. The spots enlarge during these changes, which are completed in from a few days to several weeks. Oxidation of the effused blood is the cause of the various shades.	Are not effected by time, the c maining constant until putrefaction There are no zones of color rou margin, as are noticed in vital moses.

Ecchymosed marks are sometimes found upon the skin in the livin ject, being found on the bodies of those dying from scurvy, typhus and other adynamic diseases ; or they may be located on the legs and very old persons. They are probably occasioned by a sort of stasis capillary circulation, the venous capillaries offering a sort of barrier progress of the blood. This condition has been termed *asthenic hyper* These lividities may also be found on persons killed by hanging, suffo apoplexy, or carbonic-acid-poisoning.

Under certain states of the system these spots develop spontane often covering the body in the form of *petechiæ ;* or, when extensive may constitute the principal pathognomonic character of the eruption as *purpura.*

"A peculiar appearance of cadaveric lividity is observed in bodies have been wrapped in a sheet and allowed to cool, or that have co their clothing. It occurs in the form of bands or stripes over the who face, and often gives an appearance as of a person flogged. The expla of this appearance is that the congestion of the vessels takes place interstices of the folds, while the parts compressed remain whole. T broken condition of the cuticle, together with the other characteristi mentioned, are sufficient to distinguish these ecchymoses from thos duced by violence." (Loomis.)

Cadaveric lividity makes its appearance, according to Caspar, i twelve to fifteen hours after dissolution. If death be due to hemorrh anæmia, it is very slightly if at all apparent.

VIII. **Putrefaction.**—In from a few hours to three days[1] after the death f a person, a greenish-blue discoloration appears upon the middle of the bdomen, and then gradually extends over the rest of the body. After a hort space of time the color deepens, and gradually becomes purplish or rown, being due to the action of the gases of decomposition upon the loring matter of the blood, the hæmoglobin. Simultaneously with this ange is developed the peculiar odor of decomposition. The chest, the inter- stal spaces, the face, the neck, the legs, and finally the arms are similarly scolored, this discoloration being especially marked along the venous unks of the latter. The eyeballs become soft and yielding, and, if ex- sed to the open air, the conjunctivæ and corneæ become brown in color nd dry.

In the course of a few days—five or six—the discoloration extends over e entire body, at first in spots, which gradually coalesce. Streaks of a irty-red color are now observed throughout the surface; they follow the urse of the blood-vessels. In ten or fifteen days, according to the weather, osening of the epidermis, together with the formation of blebs, occur. he tissues become flaccid, and the thorax and abdomen greatly distended om the great formation of gas. This gaseous formation causes the eyeballs protrude, and the features are so much swollen and distorted as to be nrecognizable. In two or three weeks the epidermic blebs open, the in- rease of gas continues, and the body thereby becomes enormously swollen. frothy, reddish fluid is forced from the mouth and nostrils, due to gaseous rmation in the cavities of the head and face. The cavities of the body may urst and discharge their contents. The muscles become pulpy, the whole ody finally being changed into a soft mass. The nails and hair are loosened, nd at this stage of decomposition it is difficult, if not impossible, to distin- uish the sexes, except a uterus, which is the last organ to yield to putre- ctive influence, is discovered.

These changes are subject to considerable variation, but the above de- cription furnishes the average changes as seen in a body exposed to the air t a moderate temperature. Loomis[2] has "seen bodies buried two months hat have shown fewer of the changes produced by putrefaction than others ead but a week."

The order in which the internal organs undergo putrefaction is shown, hronologically, in the following table:

INTERNAL SIGNS OF PUTREFACTION.

I. The Mucous Membrane of the Larynx and Trachea.

This membrane assumes a dirty red coloration at the same time that the greenish spot appears upon the abdomen. It should not be mistaken for congestion. Follow-

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[1] This is the usual order observed in bodies which are exposed to the atmosphere. In winter the time of commencing putrefaction is from three to six days.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. i.

ing this stage of redness, the lining membrane becomes olive-green in color, and th tracheal rings soon fall apart, the organ finally disappearing altogether.

II. The Brain of Young Infants.

This is the next organ to decompose, the process being a change of the delicat organ into a rosy, soft mass, which exudes from the smaller openings.

III. The Stomach.

This organ putrefies generally in from five to six days, the change showing itse in a dirty red color at the fundus, together with the formation of dirty red streal on the posterior wall, which soon after appear on the anterior, and then pass into dirty gray, with patches of black. These streaks may be mistaken for the inflamm tion due to irritant poisoning. Next in order of putrefaction are the various coats the organ, the traces of the change being observed in the dark-red streaks (vein running through the grayish patches, and the pultaceous condition of the organ.

IV. The Intestines.

Next in order of putrefaction are the intestines, which become greatly distende with gas, burst, and discharge their contents. They finally become a pultaceou mass. Their discoloration and other changes occurring are much the same as in th case of the stomach.

V. The Spleen.

The next organ to putrefy is the spleen. It first changes to a dark-red color then to a greenish blue, finally becoming soft and pulpy, a state that is assumed with great rapidity, especially in cases of septicæmia. If the organ was in a healthy state a the time of death, its resistance to putrefaction may last for from two to three weeks

VI. The Omentum and Mesentery.

These organs, if not diseased, may resist putrefaction for several weeks. The process, however, is accelerated if they contain much fat.

VII. The Liver.

The liver of a new-born putrefies earlier than that of an adult person, which may resist putrefaction for several weeks. It first assumes a greenish color, which soon changes to black. This color generally appears at the convexity of the organ, and finally pervades the entire structure. The organ eventually softens, shrivels, and disappears. The *gall-bladder* is recognizable for a much longer time than is the liver. In cases of fatal arsenical poisoning, the liver resists the process of decomposition for a considerable time, no doubt on account of the affinity of that organ for arsenic.

VIII. The Brain of Adults.

Putrefaction generally manifests itself in the brain of adults at the end of the fourth or fifth week, and sometimes later. It shows itself first at the base, which softens and assumes a bluish-green color; it then progresses upward and inward. Harris[1] states that the "color is more of an ashy gray, and the brain retains this color even after it has become very soft, even to the point of almost liquefaction."

Brains that have been injured in any way (depressed bone, gunshot wound, etc are affected earlier.

[1] Hamilton's System of Legal Medicine, vol. i.

IX. The Heart.

The heart is the next organ to become involved. The softening commences in the columnæ carneæ, with a progression outward toward the walls of the organ, which subsequently changes into an unrecognizable mass. The heart is one of the toughest organs in the body.

X. The Lungs.

Healthy and uninjured lungs at the time of death resist decomposition for several weeks, and it is a curious fact that, although these organs are very soft, they should resist this process so long. The first indications of putrefaction are the little bead-like bladders of air in the sulci on the inferior surface of the lobes. The structure proper of the lung turns at first green, then black, finally softening and disappearing. A differentiation between gray hepatization and putrefactive change may be possible many weeks after death. (Harris.)

XI. The Kidneys.

Next in order are the kidneys, which assume a reddish-brown color and soften, after which they become greenish black; they then disappear.

XII. The Urinary Bladder and Œsophagus.

These organs follow the decomposition of the kidneys.

XIII. The Diaphragm and the Arteries.

The diaphragm being a muscular structure similar to the heart, is capable of resisting putrefaction for a long time. The tissues of the arteries likewise resist this process.

XIV. The Uterus.

The uterus is the toughest organ in the body, and presents the greatest resistance to putrefactive change, a fact of forensic importance in considering the possibility of pregnancy, fœticide, etc. The identity of the uterus has been ascertained at the end of seven months; and Caspar refers to an instance of its recognition after it had lain in a privy vault nearly ten months; the organ was of a bright-red color, having also retained its normal shape.

CIRCUMSTANCES WHICH PROMOTE OR RETARD PUTREFACTION.

Circumstances Promoting Putrefaction.

1. *Temperature.*—The most favorable temperature for putrefaction is that between 21.1° and 37.7° C. (70° and 100° F.). Putrefaction may commence as low as 10° C. (50° F.), but it is wholly arrested at 0° C. (32° F.), below which the body freezes, and, upon thawing out, putrefies with remarkable rapidity. Putrefactive changes are arrested at 100° C. (212° F.), the body desiccating on account of loss of its fluids.

Circumstances Retarding Putrefaction.

1. *Temperature.*—Putrefaction is completely arrested below 0° C. (32° F.), and above 100° C. (212° F.). This is due to the intensifying of cohesion and the evaporation of moisture respectively. A remarkable example of the preservative power of cold is cited by Erman, who states that the body of Prince Mentchikof, that had been buried in the frozen soil of Siberia, on being exhumed, after ninety-two years' burial, was found in a state of almost perfect preservation.

The rapidity of putrefaction grows less and less as the temperature advances above 37.8° C. (100° F.). It is also retarded in bodies buried in hot sand, mummification being the result.

CIRCUMSTANCES PROMOTING PUTREFACTION—*Continued.*

2. *Moisture.*—This state promotes putrefaction by favoring solution; that is, the various organs undergo putrefaction in proportion to the amount of fluids they contain. For instance, the brain and eye contrast widely with the bones and hair or teeth.

3. *Air.*—Air promotes decomposition by carrying to the body the lower forms of organic life (micro-organisms), which have the power to bring about the change. Absence of air renders decomposition slow, as is seen in bodies which are hermetically sealed in metallic caskets. Moist air favors the process by lessening evaporation. *Still* air promotes the change. Bodies putrefy more quickly in air than in water or after interment.

4. *Condition of the Body.*—Corpulent bodies putrefy more rapidly than lean ones, on account of the preponderance of fluids; dropsical conditions favor putrefactive changes.

5. *Age and Sex.*—According to Caspar, the bodies of new-born children and of women dying in childbed decompose more rapidly than others, especially the aged. Orfila states that females change more quickly than males.

6.—*Certain Poisons.*—Caspar states that putrefaction is rapid after death by morphine, prussic acid, and narcotic poisons generally. The same is true when death follows certain animal and gaseous poisons, such as sulphuretted hydrogen and carbonic acid gases.

7. *Manner of Burial.*—Burial in low, damp, swampy soil favors the rapid advancement of decomposition; so, likewise, when the grave is shallow, so that the constant variations of the temperature reach the body. This process is also favored

CIRCUMSTANCES RETARDING PUTREFACTION—*Continued.*

2. *Moisture.*—The process of decomposition is retarded by an absence of moisture, on account of the absence of air. Dryness of the atmosphere acts as a preservative, as is seen in the dry air of the desert, where bodies have been preserved for a long time.

3. *Air.*—The prevention of the access of air to a dead body, such as by its enclosure in a close casket, by close-fitting clothing, or by complete immersion in water, retards the process of putrefaction.

4. *Condition of the Body.*—Leanness retards putrefaction by the absence of those fluids which hasten this process.

5. *Age and Sex.*—Adults and old persons decompose more slowly than children. Males change less rapidly than females.

6. *Certain Poisons.*—Poisons which actually cause death, such as arsenic, antimony, zinc chloride, chloroform, strychnine, phosphorus, etc., may be said to retard the process of putrefaction. The action of sulphuric acid, and perhaps other mineral acids, is probably to neutralize the ammonia during its formation rather than to retard putrefaction. Alcohol and arsenic are antiseptics. Lime acts both as a deodorizer and antiseptic, and may prevent putrefaction, if applied freely to a dead body, by preventing the access of air. Various other antiseptics have a similar influence.

7. *Manner of Burial.*—The burial of a body a short time after death retards the effects of putrefaction, as also does interment on high ground and in a dry and absorbent soil (sand or gravel); burial in ground over six feet in depth; burial in

CUMSTANCES PROMOTING PUTREFACTION—*Continued.*	CIRCUMSTANCES RETARDING PUTREFACTION—*Continued.*
porous soil, interring a body without ies or coffin, and by insects finding way to the body (as where it has exposed to the air before burial for g time) and depositing their ova in on it.	clothes and a well-secured casket; injection of the body through the arteries with arsenic, zinc chloride, etc.

:r of the Various Parts of the Body affected by Putrefaction in Water.[1]

/hen bodies have been submerged in water, the putrefactive changes :ss rapid than when they have been subjected to atmospheric or other ;es. Sometimes the changes are not shown for a period of twelve days, the order of parts affected is as follows: ears and temples, face, neck, ders, chest, abdomen, and legs. This order is almost the inverse e putrefactive changes produced in bodies exposed to the air, and, ding to Tidy, occurs equally whether the body be submerged alive or . Ogston states that the discolorations observed in submerged bodies nence on the abdomen.

he effect of the gases developed within dead bodies, after being in the r for some time, is to cause them to float on the surface. After remain- buoyant for a short time, the body sinks, on account of the escape of s, and rises a second time when a new supply of gas has been formed. e gases are equally developed in water as in air.

he decomposition of a body in water varies, the rapidity depending on emperature, 17.8° C. (64° F.) to 20° C. (68° F.) being the most favorable. efaction is also favored by shallow and stagnant water. The change is ded if the body is covered with mud, or if it be submerged in a cess- . These conditions are said to favor the formation of adipocere.

he *position* in which a body floats is such that either the abdomen or back is above the surface of the water, while the head and the extremi- are below the water surface. In the case of females, according to Tidy, abdomen is always uppermost.

After the removal of a body from the water in which it has been sub- ged, its exposure to the air promotes rapid decomposition, and at the of twenty-four hours the condition of the face is such that its recognition most impossible.

'orensically, the estimation of the *time* which has passed since death, in es found in the water, is of importance. The following changes of the y at different periods of time, as estimated by Devergie, are abridged 1 Tidy's work on Legal Medicine:

First Four or Five Days.—Little change; cadaveric rigidity may persist he fourth day, particularly if the water be cold.

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[1] *Vide* Death from Drowning.

Fourth or Fifth Day.—Skin of the ball of the thumb and little finger, and the lateral surfaces of the fingers, begin to whiten. This whitening extends (on the sixth or eighth day) to the palms of the hands and the soles of the feet. The skin of the face will appear softened, being of a more faded white than the rest of the body.

Fifteenth Day.—Face somewhat swollen and red ; a greenish spot begins to form on the neck and skin of the mid-sternum. The hands and feet are white and wrinkled. The subcutaneous tissue of the thorax is of a reddish color. The upper part of the cortical substance of the brain is of a greenish tint.

At One Month.—Face is of a reddish-brown color, the lips and eyelids swollen and of a greenish tint. The neck is slightly green, and a brown spot with a greenish areola is observed over the upper and middle part of the sternum. The skin is wrinkled, but the nails and hair are still intact. The scrotum and penis are distended by gas, so that the latter organ is sometimes in an erect position. The lungs become very emphysematous, and overlap the heart.

About the Sixth or Seventh Week.—The cuticle at the wrists begins to separate. The neck and thorax become very green in color.

At Two Months.—A slime, which penetrates the clothes, covers the body. The face is tremendously swollen and brown, the lips separated, and the teeth exposed. The cuticle on the arms, forearms, thighs and legs, and the middle of the abdomen is in its natural state, being an inverse order of putrefaction in the air. The skin (with the nails attached) of the hands and feet now begins to peel off, and the hair falls out, or can be easily detached. The veins are almost empty of blood, being filled with gas ; and the right ventricle of the heart will be of a jet-black color, provided the right cavities were filled with blood at the moment of dissolution.

At Two and One-half Months.—Adipocere will be formed on the chin, cheeks, breasts, armpits, and internal aspects of the thigh. The green color of the skin extends to the arms, forearms, and legs. Gases greatly distend the abdomen. The muscles are not changed in color.

At Three and One-half Months.—At this period in the stage of putrefaction, identification or the determination of age is difficult or impossible, on account of the almost complete destruction of the scalp, eyelids, and nose. The color of the skin on the breast is greenish-brown, and the centre of the abdomen of an opaline appearance, studded with small ulcerations. Other parts of the body present larger erosions. The hands and feet are bare of skin. The lungs are incapable of filling the thorax, a space between them and the costal pleura being the result ; this space contains a reddish serum.

At Four and One-half Months.—The skull is bare, owing to the complete destruction of the face and scalp. The brain shows traces of adipocere on its anterior parts. The remnants of the face, neck, and internal aspects of the thighs are entirely converted into adipocere. Indications of calcareous incrustation are noticeable on the prominent parts.

After Prolonged Submersion.—The skin becomes blue, green, and black, and as putrefaction advances, softening and discoloration of the muscles occur, certain parts being converted into adipocere. In course of time all of the soft parts of the body remaining disappear from the skeleton, which finally separates. Tidy mentions a case where a body was found drowned in a cesspool, and of its complete reduction to a skeleton in the short space of eight or nine months. This result was due to the surroundings, which prevented the conversion of the body into adipocere.

IX. **Saponification, or Adipocere.**—This change in the dead body is a modification of the process of putrefaction, due to the conversion of the body into a new substance, which was styled *adipocere*, from its marked resemblance to both fat (*adeps*) and wax (*cera*). This substance is of a cheese-like consistence, with an unctuous feel, and a yellow or yellowish-brown color. It is composed chiefly of a mixture of the fatty acids. By the analysis of Chevreul, it was shown to be a true ammoniacal soap (compound of stearic acid and oleic acid),—that is, a combination of fatty acids with ammonia. When it is formed in water saturated with lime, a calcareous base may be substituted for the ammoniacal, a result occasioned by the exposure of a body either to river-water or to a grave impregnated with water containing calcium carbonate or sulphate.

Two things are necessary for saponification,—viz., animal fat and nitrogenous matter; when kept separate, neither will saponify. Therefore skin minus its fat will not be converted into adipocere. Saponification begins in bodies where there is an extensive distribution of fat, such as in the following parts: the female breast, the cheeks, around the kidneys, the omentum, etc.

Among the circumstances which are favorable to the change are: (1) bodies of children and young persons, where the fat is abundant and superficial; (2) bodies of corpulent grown persons; (3) exposure of bodies to the soil of water-closets; (4) burial in an overcrowded cemetery, in humid soil, especially where the bodies are placed one upon the other, the lowest being first affected; (5) immersion of bodies in water, especially in running water.

A completely saponified body may remain in this state for many years, even as long as seventeen years after burial, when the various organs may be still identified. (Loomis.)

The *time* required for the production of adipocere is of forensic importance. Devergie places the time at one year when the body is submerged in water, and three years for bodies buried in the earth. These periods, under ordinary conditions, must elapse before complete conversion will be accomplished. In some cases the body changes at an earlier period; Loomis mentions instances where the bodies of new-born children were completely saponified in six weeks. Under specially favorable conditions, adipocere is not formed under three to four months' submersion in water, and six months' burial in earth. (Caspar.)

This process affects the muscles first, but finally reaches all the organs

of the body, which are changed into one shapeless mass, whose former appearance is no longer recognizable. Guntz states that the adipocere thus formed has more bulk than all the fat which originally belonged to the body. This fact is important to recollect in regard to the weight of the dead bodies of infants. (Wharton and Stillé.)

X. **Mummification.**—By mummification we understand the complete drying (desiccation) up of the body; it is another change which modifies the putrefactive process, and is the result of burial in a dry, hot soil, or the exposure of the body to a continuously cold and dry atmosphere. (*Vide* Putrefaction.)

DATA UPON WHICH AN OPINION IS FORMED AS TO THE LENGTH OF TIME WHICH HAS ELAPSED SINCE DEATH.

This question assumes great importance in cases of murder in connection with the attempt on the part of the defendant to prove an alibi, and, in the absence of direct evidence, is to be determined by attending to the signs of death occurring before and after putrefaction.

The following inferences are approximative; they cannot be positive, and, further, they are founded on the supposition that the body under examination has been exposed to the influence of the surrounding atmosphere, and has not been buried.

1. **Data from the Signs of Death before Putrefaction has set in.**—If the body is only slightly cold and the jaws show signs of rigidity, the eyeballs sunken, and the eyes glazed, death has taken place within a period of from a quarter of an hour to four hours. If, however, the entire body be perfectly cold and rigid throughout, death has occurred in from twelve or fifteen hours to three or four days. If there be cadaveric lividity (suggillation), it has probably been dead from one to four days.

2. **Data after Putrefaction.**—If the abdomen has turned green and the body is cold and pliant, the rigor mortis having passed off, death has probably occurred in from one to three days in summer, and from three to six or eight days in winter, the peculiar odor of putrefaction being perceptible.

If the greenish-yellow discoloration of the abdomen extends over the entire surface, and greenish-brown stains and dark-red lines are found, more or less, on various parts, together with relaxation of the sphincter ani muscle, then death has occurred in from eight to ten days in summer, and from ten to twenty days in winter.

If the body is of a greenish color all over, the chest and abdomen greatly distended; if blebs are found on the skin and maggots in the muscles, the nails and hair loose or falling out, the color of the iris unrecognizable, the features almost obliterated, then death has taken place within a period of from two to three weeks in summer, or from four to five weeks in winter.

If the chest and abdomen burst, and the sutures of the skull give way from the gaseous products developed within the head; if some of the bones

are bare and the eyes enormously swollen; if the viscera appear pulpy, or have perhaps disappeared, death has occurred within a period of from two to four months.

In giving an opinion on this question, the legal physician must consider, besides the condition of the various organs of the body, the mode of death, the quantity of clothing worn by deceased, the season of the year, the heat and moisture to which the body has been subjected, etc.

Another question arises here,—viz., *Of two persons found dead, which expired first?* This sometimes becomes a question of great importance, often presenting itself to the legal physician. It was well brought out in the celebrated "Lizzie Borden case," by establishing the fact that Mrs. Borden was dead two hours before her husband, proved by an analysis of the food in the stomachs.

CHAPTER XX.

MEDICO-LEGAL AUTOPSIES.

General Considerations—Surrounding Objects and Position of the Body—Examination of the Body before the Clothing has been removed—External Examination of the Body—Internal Examination of the Body—Post-Mortem Dissection Wounds—Medico-Legal Reports—Table.

THE object of the medical examiner in performing an autopsy may be to determine whether an individual has died from the effects of violence or poisoning, to assign the cause for a sudden death, or to observe and study the various pathological changes and lesions occasioned by disease. In any case, accuracy of observation and completeness of detail are necessary.

In the case of a medico-legal investigation, the physician who undertakes it assumes a very serious responsibility, and he will save himself an enormous amount of trouble, time, and vexation if he will prepare himself well to meet the various contingencies that may present themselves. His duty should be performed with strict impartiality, entirely free from bias, and unshackled by fear or favor; and, finally, he should be an able anatomist and pathologist.

In all cases where disputes are likely to arise, it is advisable that the autopsy should be conducted by or in the presence of two medical examiners, and the suspected individual should be represented by an expert or friend of his own selection.

An examination of a body after death, as ordinarily undertaken for the purpose of ascertaining the cause of death, where this is due to the effects of disease, concerns the physician himself, the relatives or friends of the deceased accepting the results of his inquiry without question or hesitation; therefore, with the signing of the death-certificate the duties of the medical examiner are at an end. Not so, however, if the case be one of forensic

interest, because upon the report of the examination and the subseq testimony will depend the issue of a civil damage suit, or the arrest and of a person suspected of criminality, such as homicide, etc. Therefor order that the course of justice may progress untrammelled, the legal sician should be eager in his efforts to assist the court in the discover truth; for it should not be overlooked that loose and inaccurate meth upon his part may be the cause of jeopardizing the liberty of a citizen the one hand, or the vindication of the law on the other.

An autopsy should always, if possible, be conducted by unobstru daylight, since artificial light might interfere with correct color interpreta such as stains of nitric or of picric acid, and other spots. If the ex nation is to be made in a private house, the available room should be l and well ventilated. The body may be placed upon a high kitchen table left lying upon the stretcher furnished by the undertaker. An autopsy sh never be performed while the body is in a casket, on account of the uns factory results. The utmost cleanliness must be observed, and suit cloths should be in readiness to protect the floor around the body; provision must be made for the presence of wash-basins with hot and water, soap, cloths, aprons, disinfectants, etc.

In the case of a *frozen* body, it must be allowed to thaw thorou before attempting the autopsy. This should be done by placing the in a warm room until the parts are sufficiently thawed, and not by imme in warm water or other warm substances.

If the body to be examined be *embalmed*,[1] great care must be tak observing the appearances of the various tissues, etc., because the em ing preparation used is capable of modifying the color and consisten the parts with which it comes in contact.

A post-mortem examination is best performed with the following *in ments* at hand, although some of them are not absolutely required: (1) section knife, with deeply-bellied blade, well-rounded point, and a larg heavy handle; (2) scalpels; (3) brain knife, for incising the solid or (4) curved, probe-pointed bistoury, for cutting through the dura mater, (5) Valentine's razor-like double knife, for making thin sections; (6) tome, or large bone-forceps, for cutting ribs; (7) scissors, large and for incising vessels and canals of various kinds, also an ordinary-sized with one blunt and one sharp blade; (8) enterotome, useful for openin intestines, heart, etc.; (9) dissecting forceps, two or more pairs of diff sizes; (10) probes, large and small; (11) grooved director; (12) ch (13) blow-pipe with stop-cock; (14) saws; (15) measuring and grad glasses; (16) post-mortem needles and strong twine; (17) mallet, wooden or rawhide; (18) scales; (19) metal and flexible catheters, lit paper, vessels, sponges, bottle of flexible collodion, Lugol's solution of i for the amyloid test, plates, and magnifying lens.

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[1] *Vide* Embalming in its Medico-Legal Aspects.

Besides the above instruments, a microscope and adjuncts are necessary carrying on a satisfactory and complete examination. Of course, an opsy can be performed with a few of the above-mentioned instruments, h as knives, scissors, forceps, and a saw ; but, in order to make an examiion as thorough as possible,—a *desideratum* in medico-legal cases,—all necessary appliances should be within reach.

For the reproduction of wounds, so as to fix their location on the body, d for other purposes, a photographer's camera is an exceedingly valuable cessory. Tubes with sterilized media (for inoculation), an alcohol lamp, ecting syringes and solutions, and bottles and jars should not be forgotten.

In cases where *microscopic* or *chemical examinations* become necessary, e parts required should be placed in new glass jars with close-fitting glass vers, with or without alcohol,[1] and sealed, numbered, labelled, and inilled, so as to facilitate subsequent identification. In cases of suspected isoning, the medical examiner should preserve for the chemist the stomach, tire intestinal canal, the liver, both kidneys, the spleen, a portion of muscle m the leg, the brain, and any urine remaining in the bladder. In case e whole of any organ cannot be obtained, the part removed should be ighed and its proportion to the rest of the organ ascertained.

When possible, it will be best to make the autopsy within twenty-four urs after the death of the person, although, according to some authorities, e sooner it is performed after dissolution the better for the finer results. n the other hand, putrefaction or long burial should not be allowed to etract from the thoroughness of medico-legal investigations, nor afford justication for declining the examination. Much useful information may be btained from such examination, such as abnormalities, injuries to bones, oreign bodies in various parts, such as bullets, etc. Notes of the autopsy hould, of course, be made.

Surrounding Objects and the Position of the Body.—The surroundings should be first noted, such as *locality*, or the place where the body was found, as where the body of an infant is discovered in a privy vault, etc. Sometimes the body may be found in a position which could not have been assumed by the dead person ; or, again, it may have been dragged over the ground by the assailant to a distant place, or the victim may have followed his murderer after having been dealt the fatal blow, and thus perished at a distance from where the assault originally began. The presence of footmarks and their direction, together with the character and condition of the soil, should be noted. These latter signs, together with the presence of any weapon, may show evidence of struggling. In winter the condition of the snow will materially aid one in arriving at definite conclusions which would otherwise be difficult of presentment.

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[1] Where the different organs can be delivered to the chemist at once, preserving fluids should not be used ; but if employed, a sample should be retained, that the chemist may test the same for any impurities.

If the dead person is found in a room, then the exact position in which the body lies, especially the position of the hands and feet, is important. Its relation to articles of furniture, to weapons, to cups, glasses, and bottles from which poison may have been taken, and to blood-stains on the floor, walls, etc., should be carefully ascertained and noted. The importance of examining into such details was forcibly illustrated in the "Webster case," New York. If possible, a photograph of the body should be taken in the exact position in which it was discovered; this also may be of importance as a possible means of future identification.

When a body to be examined has been removed from its grave, the character of the surrounding soil should be ascertained, for the question of preservation of the body may arise in court during the process of a trial. Again, if a body be found in a pool or stream of water, the temperature and character of the latter should be noted. Finally, a diagram or sketch of the position in which the body was discovered, especially its position in relation to surrounding objects, should be made.

Examination before the Clothes are removed.—The medical examiner should note the exact position of the body when found, particularly in cases where death was occasioned by wounds. The examination of the clothes should be very thorough, noting whether they are torn or cut or stabbed, ascertaining the exact position of all cuts and their correspondence with injuries or wounds upon the body; also whether any piece or fragment of cloth subsequently found tallies with the garment of the suspected person or that of the deceased. Observe whether the clothes are stained with blood, acids, etc. (All articles of clothing should be preserved for evidence.)

The condition of the hands should be noted,—that is, whether they contain in their grasp hair, clothing, etc., or whether they are blackened or burned with powder, stained with blood, or otherwise injured. The attitude and position of the limbs, the condition of the hands, etc., may assist the examiner in discovering whether or not a struggle occurred before death. (*Vide* Wounds.)

External Examination of the Body.—All clothing, including the stockings, is to be removed, and the body placed upon a high table in the supine position. The inspector of the body takes particular notice of the following points:

1. The *signs of death*, *decomposition*, and *external pathological* or *traumatic changes*. Any circumstances which tend to throw light upon the time at which death occurred should be carefully noted.

2. The *stature*, the *sex*, the probable *age*, and the *weight* of the individual should be ascertained.

3. The *temperature* of the body should be taken.

4. The *rigidity* or *flexibility* of the *extremities* should be noted.

5. The *color* of the *skin;* note whether there are any marks or scars, or any spots of cadaveric lividity, and, if so, ascertain their situation.

6. *Abnormalities* or *peculiarities*, such as club-foot, spinal disease, excess or deficiency of limbs, etc.

7. The *color* of the *hair* and *eyes*. Also note whether the pupils are large, small, or unequal; whether the cornea is transparent and tense or opaque and loose.

8. The *color* and *expression* of the *face;* also ascertain the condition of the cavities of the mouth and nose.

9. *Contusions* —If present, ascertain their situation, character, breadth, length, and depth. (*Vide* Vital Ecchymosis *vs.* Post-Mortem Ecchymosis.) Contusions produced by blows after death cannot be distinguished from those occasioned during life.

10. *Wounds.*—Note their depth, extent, and direction; also the condition of the margins of the wound, changes in adjacent tissue, and whether caused by a knife, bullet, or other weapon. If necessary, the wound may be enlarged without interfering with its original character. Injuries without any solution of continuity should induce the medical examiner to look for internal trouble. In the case of bullet-wounds, the course and direction of the ball should be noted; also the presence or absence of foreign bodies in the wound. To distinguish between ante-mortem and post-mortem wounds, observe the following points: slight hemorrhage, non-contraction of the edges, and absence of blood in the tissues are characteristic of post-mortem wounds. There is no differential point between wounds made within two hours after death and those inflicted during life. (*Vide* Wounds.)

Sometimes a weapon is found near an injured body, and the questions arise whether the injuries could have been inflicted by the weapon in evidence, and whether they could have been done by the deceased person. Again, if a body is found wounded, without the discovery of a weapon, the questions arise, What kind of weapon was employed to cause the injuries? In what manner was it used? etc. These points will be considered farther on. (*Vide* Wounds.)

11. *Fractures.*—These, when present, require consideration as to their situation, bones involved, and contusion of the soft parts, if any. Fractures occasioned during the life of a person are always followed by a greater extravasation of blood, more injury to the soft parts, etc., than those produced after death. Post-mortem fractures are much more difficult to produce than those inflicted during life.

12. The presence or absence of *foreign bodies* in the *mouth*, *nostrils*, *anus*, or *vagina*.

13. *Condition of the Genitals.*—These should be examined for injuries, syphilitic lesions, etc. In the female, note the same, and ascertain the presence or absence of virginity.

14. *Œdema of the Feet.*—Ascertain, if present, its situation and extent.

15. *Burns.*—Make note of the parts involved, whether they are inflamed, blistered, etc. (*Vide* Burns.)

16. Appearances due to electricity, lightning, hanging, etc. (*Vide* those subjects.)

Internal Examination of the Body.—The following order should be observed in the examination of the interior parts of the body :

1. **The Head.**—The scalp should be carefully examined for wounds and scars, and the condition of the hair observed ; the color of the lips and nose should be noted ; also the condition of the teeth, situation of the tongue, etc. In some cases the mouth will be found firmly closed, on account of the rigor mortis, necessitating the use of a chisel to open it.

After the above examination, the scalp should be separated by an incision down to the bone and across the head from ear to ear ; the flaps are then everted in both directions, showing the skull. Now look for ecchymoses and inflammatory changes on the internal surface of the scalp and the pericranium ; also for fractures or injuries to the outer table of the skull, avoiding the error of mistaking them for irregular sutures. Notice any abnormal shape of the skull or unusual thinness of the bone.

With a saw, a circular incision is made through the cranium, about half an inch above the external auditory canal, and the top or skull-cap removed. The incision is carried in front to a point about three and one-half inches above the bridge of the nose, and behind through the external occipital protuberance. Remove the calvaria, and examine the external surface of the dura mater, noting its color, the condition of its vessels, the presence of Pacchionian bodies, any morbid changes, etc. If this membrane is very adherent to the calvaria, so that the latter cannot be torn from it without cerebral injury, it may be removed with the bone by cutting through it at the level of the cranial incision. After opening the longitudinal sinus, examine it for thrombi. The dura mater is then removed by a careful incision around, following the cranial incision, and the condition of the *arachnoid* and *pia mater* noted. In old persons the latter membrane is often thick and white, being especially marked along the longitudinal fissure and large vessels. Ascertain the degree of congestion, the existence of serum, pus, or blood under, within, or above it.

After examining the upper part of the *brain* as to congestions of its vessels, laceration, or extravasation of blood upon its surface, remembering that this latter condition is frequently observed on the side opposite to the external injury, it is carefully removed by raising the anterior lobes with the fingers of the left hand, and incising the nerves, vessels, and tentorium as they are presented. The medulla oblongata is divided across as low down as possible, and the brain removed. The base of the skull should be examined for fractures. Next, the brain is laid upon its convex surface and the arteries at the base examined for atheroma, thrombi, emboli, and aneurisms. Look for evidences of extravasations of blood, tumors, and inflammatory lesions. The brain is then turned over on its base, and an incision carried downward and outward at the junction of the corpus callosum with the cerebrum, after separation of the two lateral hemispheres, when the roof

the lateral ventricles will be cut through and their cavities exposed. The sion thus made is prolonged forward and backward, so as to expose the nua. The size, shape, and contents of the ventricles should be observed, l the appearance and thickness of the ependyma. Hemorrhage should be ght for on the floor of the lateral ventricles, and, if present, its size and parts involved by it noted.

This done, the brain should be sliced horizontally (one-sixteenth of an h apart) through the ganglia, exposing any lesions that might be in its stance. Further incisions are carried outward into the hemispheres nearly the pia mater, with the result of forming long prism-shaped pieces joined the pia mater and a trifle of the cortex, and allowing the subsequent folding gether of the brain, so that the relations of lesions to the organ as a whole y be investigated. Next, the fornix and corpus callosum at the foramen Monroe are incised and the third ventricle examined. An incision through lower portion of the vermiform process opens the fourth ventricle, which ould be examined as to its contents and the condition of its vessels and endyma. The floor of this ventricle is divided by making transverse in- ions (one-sixteenth of an inch apart), and examination is made for minute morrhages. The hemispheres of the *cerebellum* are next opened by in- ions made from the fourth ventricle and passing outward into its substance, closing the presence of any tumors or hemorrhage in the cerebellum.

Sometimes the removal of the *eye* is called for. When such is the case, removal is accomplished by breaking through the roof of the orbit with hisel and removing the muscles, thus exposing the optic nerve and the sterior part of the organ.

2. **The Spinal Column.**—To examine the cord and its membranes body should be placed on its face with a block beneath the thorax. An ision is made through the skin, subcutaneous tissue, muscles, and the cia connected with the spinous processes, extending from the occipital otuberance along the spines down upon the sacrum. After the soft parts e dissected away from the laminæ out to the articular processes, the ver- bral arches are fully exposed. The laminæ are then sawed through close thin the articular processes, so as to open the spinal cavity at its outer argins (Luer's rhachiotome, a double-bladed saw specially adapted for this ork, should be used, although a single-bladed instrument accomplishes e same with more time). The laminæ and spinous processes are now moved by means of a stout hook, and the cord is brought to view. Great re in the use of the saw must be exercised, so as not to injure the cord. ext, the roots of the spinal nerves are divided and the cord is removed, gether with its membrane. It is laid on a clean board or table and the ura mater laid open with blunt-pointed scissors on the anterior and pos- rior surfaces over its entire length, and an examination made for inflam- atory lesions, tumors, etc. Softening or sclerosis of the cord can generally e discovered by passing the finger gently along it. The cord is now divided y transverse incisions (half an inch apart) through its entire length, allow-

ing the segments attached to the pia mater to remain, and the incised surfaces are carefully examined for hemorrhages, softening, scleroses, inflammatory lesions, and pigmentations. After the removal of the cord the vertebral column should be examined for fractures and dislocations.

3. **The Neck.**—Note if there be any marks of violence by the fingers, such as would result from garroting, or by a cord round the neck (strangling or hanging) ; also carefully inspect the neck for ecchymoses, and observe whether the great vessels are full or empty and the nerves in their natural state. Examine the cavity of the nose and mouth, likewise the ears for the presence of blood and other fluids or foreign bodies. The neck should also be examined for glandular enlargements, etc., and the condition of the larynx, trachea, pharynx, and œsophagus noted.

4. **The Thorax and Abdomen.**—The body is replaced on its back, and a single incision, from the top of the sternum to the pubes, is made, dividing the skin, fascia, and muscles, and passing to the left of the umbilicus to avoid the round ligament of the liver. A short cut is then made through the peritoneum below the xiphoid appendix, and two fingers of the left hand are inserted and separated, the parietes being raised so that the peritoneum can be divided to the pubes without damaging the intestines. The skin and muscles are next dissected from the chest on both sides as far back as the false ribs. In order to turn the abdominal walls to the side, the recti muscles are severed subcutaneously near their insertion in the pubes. The cut surface of the chest and abdominal muscles should be examined as to their color, amount of subcutaneous fat, and consistency ; also note whether the former muscles show any evidence of trichinosis or other parasitic disease. The fulness of the mammary glands, together with the presence or absence of milk, should be ascertained in women. These glands should be opened if necessary.

A superficial examination of the *abdominal cavity* should be made now in order to avoid any possible change in the position of the organs or mixture of fluids that might follow the previous opening of the thoracic cavity. I cases of forensic importance, when the cause of death is believed to exi within the abdominal cavity, it is a rule to examine the organs containe therein first, with, of course, such modifications as the special indications c the case require.

Inspection of the abdominal cavity includes the relative position an general condition of the various organs, the condition and color of th peritoneal surfaces, abnormal adhesions, and the amount of blood in th presenting parts. Examine carefully for various forms of hernia and oth intestinal malpositions. Note the condition of the vermiform appendi the amount of fluid in the cavity of the abdomen, and whether there ar any signs of inflammation, or evidence of tumors or other foreign bodies The determination of the height of the diaphragm is of importance, sinc there are a variety of pathological conditions which change its position.

The omentum should be raised and laid over the lower thoracic wall, i

rder that the small intestine can be more readily inspected; for this purpose should be raised out of the pelvis, after which any abnormal contents in he peritoneal cavity will be brought to view; and, if fluid, its quantity, color, onsistence, and nature should be ascertained. In women an examination f the pelvis shows the size and shape of the uterus and the condition of the road ligaments and the ovaries. The ileo-cæcal region seems to be the ost frequent site of old adhesions in women, where they are generally oined with the vermiform appendix, about the gall-bladder and around the pleen.

5. **The Thorax.**—The cartilages of the ribs with the sterno-clavicular gaments are divided, the incision being downward, outward, and backard, the knife (costotome) being held in an oblique position so as not to amage the parts beneath. By a semilunar incision the clavicles are sepaated at their attachments to the sternum. The latter bone is now raised ith the left hand and reflected. Notice the condition of the lungs, also heir position, color, whether adherent, collapsed, or emphysematous. If uid is seen in the pleural cavity, notice the amount and nature. Complete istention of the lung is observed when death is occasioned by drowning or uffocation. Open the pericardium, and note the presence and amount of luid, if any.

The *lungs* are removed by passing the hand under them, noticing any dhesions, and lifting them from the pleural cavity and severing the vessels and bronchi at their base. The external surface of the organ should be examined as to shape, color, and consistence. Then open the large bronchi with scissors (blunt-pointed) and extend the incision into the pulmonary substance along the minute bronchi. The condition of the bronchial tubes and pulmonary artery should be noted and the presence of foreign matters in the air-passages (in case of drowning) ascertained. Any blood which has escaped into the thorax should be removed with a sponge, so as to note the color of the parts. The next process is to turn the lung over, grasp its base in the left hand, and make an incision extending from the base to the apex. This will expose the pulmonary surface, which should be examined as to color, and whether the alveoli contain serum, blood, or inflammatory products; these latter cannot be forced from the lungs by pressure, while the serum and blood can. The presence or absence of miliary tubercles should be ascertained. (The hydrostatic examination of the lungs will be considered farther on.)

It is best to examine the *heart in situ* before removal. Note its size and the fulness of the coronary vessels; also whether there is any evidence of aneurism or dilatation. The organ is then firmly grasped at the apex and removed by severing the vessels at its base. Note its weight, condition of the tissues (sometimes microscopically), thickness of the walls of the ventricles, capacity and size of the valves, and condition of the organ generally.

The right ventricle of the heart is opened by making an incision over its

anterior margin near the septum. By extending the incision to the apex and upward through the pulmonary artery, the cavity of the ventricle will be disclosed. Normally, the tricuspid valves will admit the presence of three or four fingers; in this manner the size may be estimated. The cavities on the left side are similarly opened by making an incision through the anterior wall of the left ventricle and prolonging it upward through the aortic valve. They often contain blood-clots, usually of post-mortem origin, which are readily distinguished from those formed previous to death by their succulent, moist condition and reddish-yellow color; they are easily detached from the walls of the cavities. Ante-mortem clots are of a whitish color, usually dry, and of a firmer consistence; they are rarely observed after death. The next procedure is to note the condition of the endocardium, which is often stained a deep red, due to the absorption of the coloring-matter of the blood set free by decomposition. Ascertain the size of the cavity and the thickness of the walls of the organ, which may appear unusually flabby on account of decomposition. The auriculo-ventricular valves are completely exposed by introducing the enterotome into each auricle and extending the incision through the mitral and tricuspid valves to meet the former incision, which has been prolonged through the ventricles, at the apex.

The blood should be removed and weighed. The *aorta* may show signs of dilatation, atheromatous changes, or calcareous deposits.

6. **The Larynx and Œsophagus.**—An incision should be made from the chin to the upper part of the sternum. Dissect the soft parts away on either side of the larynx and thyroid gland; cut along the inner surface of the inferior maxilla from its symphysis to the angle, and through this opening introduce the fingers into the mouth and pull down the tongue. The trachea and œsophagus can be removed together by severing the posterior wall of the pharynx (a ligature should first be applied to the œsophagus at its lower portion). The pharynx and œsophagus should now be opened along their posterior margin, and evidences of inflammation, tumors, caustic poison, foreign bodies, and strictures looked for. Next open the larynx and trachea along their posterior wall with an enterotome; note whether there is any sign of œdema of the glottis, and also the condition of the mucous membrane. The thyroid gland should be removed and examined.

7. **The Abdomen.**—Returning to the abdominal cavity, the next procedure is to cut away the *omentum*. The examination of the intestines, except in gunshot wounds of the abdomen, is best left to the last, for the sake of cleanliness. The abdominal viscera, therefore, will be inspected in the following order: the omentum, the spleen, the kidneys, the sexual apparatus, the stomach and duodenum, the liver, gall-bladder, bile-ducts, and portal veins, and, lastly, the abdominal aorta, the receptaculum chyli, lymphatics, etc.

The *omentum* may afford an opportunity for the study of miliary tuber-

s, disseminated carcinosis, or inflammatory changes. For this purpose a all piece should be cut from a portion that contains little or no fat.

The *spleen* is situated obliquely at the left side of the stomach, and posses little or no forensic interest. It is readily detached and removed from body. Note its size, color, and consistency, which may vary considera-; also whether there are any abnormal thickenings of its capsule or ercles or tumors in its substance. Decomposition softens it. Sometimes s ruptured as a result of violence.

The *kidneys* are removed from the abdominal cavity by separating the ritoneum from them and dividing the vessels and ureters as close to the dder as possible. These organs may be softened as a result of putrefacn, or their surface may have a greenish color owing to the post-mortem ion of putrefactive gases on the hæmoglobin of the blood. The color, e, and weight of the organ should be ascertained. The next step is to ride the kidney into two parts; this is done by firmly grasping the organ the left hand, and making an incision in its capsule along its convex rder, when the membrane is stripped off and examined as to its degree adherence. Note whether the surface of the organ is smooth or granu-r, pale, congested, or mottled. The organ is then completely divided into lves by prolonging the incision already made through its cortex, inward ward the pelvis. The internal structure should now be examined. Note e thickness of the cortex, which should average one-third of an inch; so its degree of congestion, and whether the normal light and reddish riations are observed running through it. If these alternating light and ark striations are absent and the organ has not felt the influence of deomposition, various forms of Bright's disease may be suspected. If waxy egeneration be present, the cut surface of the organ should be washed ith water and brushed with a few drops of Lugol's solution of iodine iodine, 5 parts; potassium iodide, 10 parts; water, 85 parts), when the amyloid areas will appear as mahogany-colored dots and lines on a yellow background.

The pelvis of the kidneys should be examined for inflammatory lesions and evidences of calculi. Occasionally a whitish fluid, produced by postmortem desquamation of the epithelium, is seen in the pelvis; it may be mistaken for pus.

The *suprarenal capsules* are of a triangular shape, being situated at the upper and inner border of the kidneys. They readily decompose; but if this process is not too far advanced, hypertrophy, tuberculosis, tumors, and cheesy degeneration are to be looked for.

Where narcotic poisoning is suspected, the examination of the renal organs should be exact and thorough.

The *bladder* may be examined *in situ*. After drawing off the urine, it should be set aside for future examination, especially in poisoning cases. Careful examination of the walls of the viscus should be made, particularly in cases where fracture of the pelvis exists. Perforating wounds are deter-

mined by filling the organ, before opening it, with water or air through the urethra.

In case it becomes necessary to remove the entire organ, care should be taken not to injure it in any way. The further examination of the male genito-urinary system is hardly required; but if it is desired to remove the *penis*, it may be stripped out of the skin and severed at the glans, being removed with the bladder attached. Note the condition of the urethra, whether there are evidences of strictures, diverticulæ, inflammatory lesions, etc.

The Female Organs of Generation.—The inspection of these organs becomes of great importance in connection with criminal operations. The external generative apparatus should be carefully examined for lacerations, hæmatoma, inflammation, and neoplasms. In medico-legal cases of suspected abortion or rape, punctures may be found in the external genitals, occasioned by the bungling use of instruments, as well as the ordinary lacerations due to childbirth. In rape cases there are lacerations, swelling, discoloration, and often purulent inflammation, especially in the case of children. The condition of the *vagina* should be ascertained; note its color, presence or absence of rugæ, condition of the hymen, etc. This canal may be thoroughly inspected by incising it on the left side up to the cervix uteri and separating it from the anterior surface of the uterus. The *uterus* should be measured externally in its longest, broadest, and thickest diameters. The position of the organ should be noted, and it must not be overlooked that retracting perimetritic adhesions may sometimes affect the position and shape of the organ. Observe, before incising, the appearances of the external os, whether it is changed by childbirth, etc. Open the organ by an incision from the fundus to the cervix; also make two shorter incisions from the upper end of and at right angles with the previous cut, outward toward the uterine openings of the Fallopian tubes. Next measure the thickness of the walls, and at the same time note the relative size of the cervix compared to the body of the organ. Another important point is to examine the uterine vessels and the thickness of their walls. These observations may show whether any previous pregnancy has taken place or not. Ascertain the condition of the mucous membrane and muscular tissue of the uterus, whether it is normal, congested, covered with mucus, dark-colored (after abortion), etc.; also whether there are any remains of decidua, etc. The cervix may be hypertrophied, ulcerated, etc., conditions which must be carefully ascertained and noted. The *ovaries* are to be examined as to size, condition of the surfaces, and shape. After bisection of the ovaries by a longitudinal incision, the color, state of the Graafian vesicles, the corpora fibrosa and lutea, possible abscesses and cysts, etc., should be ascertained; also any diseased conditions that may be present. The condition of the *Fallopian tubes* should receive attention, and the possibility of tubal pregnancy should be borne in mind.

The Stomach and Duodenum.—The examination of these organs be-

comes of great importance in cases of suspected poisoning. The position and the fulness, together with the color and smell of the stomach and duodenum, should be carefully noted. These two organs are removed together. The enterotome is introduced into the duodenum at its transverse portion, dividing it along its convex border; when the pylorus is reached, the incision is continued over to the greater curvature of the stomach as far as the esophageal opening. Previous to the operation just described (in cases of poisoning), a double ligature should be placed around the lower end of the esophagus above its junction with the stomach, the duodenum being tied in the same way in two places. The two organs are then removed together unopened, placed in a clean wide jar, and emptied by raising the cardiac end of the stomach. The stomach contents should be examined as to quantity, color, odor, and reaction, and the presence or not of undigested food, alcohol, or crystalline matter ascertained. It is customary to place portions of the contents in glass bottles for preservation and subsequent microscopical examination. The mucous membranes of the stomach and duodenum should now be examined for evidences of erosions, hemorrhages, tumors, and acute or chronic inflammations. Note the appearance of the rugæ and interspaces, and also the condition of the blood-vessels. Post-mortem redness of the stomach should not be mistaken for the effects of poison or the marks of disease, nor ulcers or perforations due to disease for the results of irritant poisons. Perforations of the stomach from the effects of caustics are readily distinguished from those of spontaneous origin by noting the irregular edges of the opening, which are of the same thickness as the rest of the organ, and the more or less inflamed condition of the parts not affected.

The *liver* frequently undergoes changes as a result of certain poisons. It should be removed from the abdominal cavity for examination. The diaphragm should be cut on each side, together with the suspensory and lateral ligaments, the right and left lobes having previously been raised. Ascertain the weight, measurements, and size of the organ. The *gall-bladder* is then examined as to the presence or absence of gall-stones, inflammatory lesions, and tumors; also note the amount and character of the bile. The peculiar discoloration of the surface of the organ is due to the gases generated by decomposition. Note the character of the surface, whether it is smooth or rough. To open the liver, deep incisions in various directions are made. The color and consistency of these cut surfaces should be noted; also the blood-supply of the liver-tissue, and evidences of amyloid degeneration, tumors, or abscesses. Phosphorus is the only poison that leaves characteristic appearances in this organ.

The *pancreas* is readily removed. Its size and weight should be noted. Make a longitudinal incision into the organ, and examine for evidences of acute or chronic inflammation, tumors, calculi, amyloid degeneration, and fat-necrosis. Post-mortem staining of this organ produces a dark-red color.

The posterior wall of the abdominal cavity should be examined after removal of the organ.

The *receptaculum chyli* and *lymphatics* may be examined in certain cases, to determine, if possible, the relation of the time of death to the ingestion of food. (*Vide* table at end of chapter.)

Post-Mortem Dissection Wounds.—These are contracted in the examination of dead bodies, and occur in the form of punctures, abrasions, or slight incisions. Not infrequently a pre-existing scratch or abrasion is the channel through which inoculation is effected.

The poison is probably generated shortly before death, or soon after, its development being due to a vitiated state of the blood, and its virulence to inoculation from the bodies of those who have died from such affections as puerperal fever, erysipelas, carbuncle, phlebitis, pyæmia, carcinoma of the liver, etc. When the poison is communicated by persons dead of strangulated hernia, it is peculiarly dangerous.

When the virus is once formed, it becomes independent of its source. Gross mentions an instance which came under his notice, in the person of a young cutler, who, in sharpening some dissecting instruments which had not been in use for some months, slightly pricked one of his fingers, with the result that the hand and arm soon became very painful and swollen, showing a characteristic red line extending up as high as the axilla, the glands of which were speedily involved; a month's time was required ere the immediate effects of the injury passed off.

Some persons seem to be peculiarly susceptible to the effects of this poison; disordered health, general debility, mental anxiety, etc., may predispose to the development of the trouble.

After a very brief period of latency, well-marked *symptoms* become manifest. The patient complains first of a smarting, stinging, and burning sensation about the part inoculated, which is usually covered with a whitish vesicle, filled with serum, over an indurated reddish base. The part is extremely sensitive to the touch. In the course of twenty-four hours the vesicle ruptures, showing a small ulcer, with a thin and sanious discharge and foul base. At about this time the pain is distressing, burning, and pulsatile; there is loss of sleep, and the affected part is hot, tense, heavy, and numb. The sore begins to enlarge, and the swelling increases in size; the course of the absorbent vessels of the arm is outlined by a red line extending from the point of inoculation to the axilla. Soon the whole limb becomes enormously swollen, pits on pressure, and exhibits an erysipelatous appearance. Accompanying these changes is an increase of pain, and, in very severe cases, inflammatory extension to the summit of the shoulder or to the corresponding side of the body.

In some cases the symptoms are just the reverse of the above. There may be an extension of the inflammation up the neck and down the side of the body, the involvement of the arm being only slightly apparent; or, as sometimes happens, the limb is entirely free from the trouble.

In the great majority of cases the symptoms are local, being confined to e parts adjacent to the original injury. Under such circumstances the tient usually complains of feeling unwell,—headache, want of appetite, some illiness and aching of the limbs, etc. There is no apparent disturbance of e general health. The latter takes place only when the poison has gained ll admission into the general system, when the symptoms are apparent in om twelve to twenty-four hours.

The *prognosis* depends, in some degree, upon the course of the symp-ms. When the trouble is strictly local, ultimate recovery is, as a rule, ertain, although the part immediately affected may become useless. In the vere cases fatal results may show themselves within thirty or more hours, e nervous system being apparently under the complete influence of the oison, there being very little evidence of local disease. In other cases arked with severity the patient may survive five or six days, and then uccumb to the violence of the resulting inflammation. In still other cases, eeks or months may elapse before the patient finally succumbs to the onstitutional irritation occasioned by abscesses formed in the limb or near o the affected area. The prognosis is therefore uncertain.

The *treatment* is both preventive and curative. All abrasions, cuts, etc., pon the exposed skin should be either cauterized or securely covered with ome impermeable material before beginning a post-mortem examination. As soon as a wound of this kind has been received, the affected part should be thoroughly washed, and instantaneous interruption of the venous and ymphatic circulation effected by any constricting band. The skin about the wound should be disinfected with strong antiseptic solutions, and the injured part enlarged, if necessary, by making an incision with a sterilized instrument. Bleeding should be encouraged, also the flow of lymph. A strong solution of carbolic acid (ninety-five per cent.) should be applied to all parts of the wound, and the constricting band removed and succeeded by a wet antiseptic dressing. A post-mortem wound should never be closed with collodion or caoutchouc solution. Previous to the application of the cauterizing fluid the wound should be thoroughly sucked.

If an infective inflammation appears, freely incise the wound and curette the indurated tissue. For the pain, apply chloral (gr. xx. to water ℥i) locally. The extension of the lymphangitis may be controlled, in some cases, by applying a circular blister about the arm. The constitutional effects of these wounds (fever, pain, loss of sleep, etc.) should be treated with febrifuges, anodynes, etc.[1]

Medico-Legal Reports.—In drawing up a report of the post-mortem appearances of a body, and the conclusions based thereon, the examiner should be exceedingly careful to avoid the use of technical terms, or, when their employment is necessary, should embody their significance in parenthesis. In a word, the report should be an accurately recorded statement

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[1] *Vide* Infanticide for Examination of New-Born Children.

of the observations at the time they were made, framed in language s any coroner's jury can understand.

TABLE. (After Tidy.)

ORGAN.	WEIGHT.		MEASUREMENTS, TENTS, ETC.
	Male.	Female.	
Brain	49½ ozs.	44 ozs.	
Spinal cord	1 oz. to 1¼ ozs.		15 to 18 in. long.
Thymus (at birth)	½ oz.		
Thyroid body	1 oz. to 2 ozs. (largest in females).		
Lungs { right / left	24 ozs. / 21 ozs. } = 45.	17 ozs. / 15 ozs. } = 32.	
Heart	9½ ozs. This organ bears a direct proportion to the weight of the body generally.	8¾ ozs.	About the size closed fist (5 in in. x 2½ in.). cumference 9.2 widest part.
Orifices of the heart:			
Mitral	. . . .	. . . .	4 in. circumferenc
Tricuspid	. . . .	. . . .	4½ in. circumfere
Aortic	. . . .	. . . .	3⅙ in. circumfere
Pulmonary	. . . .	. . . .	3½ in. circumfere
Stomach	4½ ozs.	Slightly under 4½ ozs.	Length 10 to 12 i ameter at wides when moderate 4 to 5 in.
Liver	50 to 60 ozs.	45 to 55 ozs.	12 in. x 4 in. x 2 i
Spleen	5 ozs. to 7 ozs. (May vary even in health from 4 to 10 ozs.)		
Pancreas	2¼ ozs. to 3½ ozs.		
Kidneys { right / left	4½ ozs. / 5½ ozs.	3⅔ ozs. / 5 ozs.	
Suprarenal capsules (each)	1 to 2 drachms.		
Ureters	. . . .	. . . .	Length 14 to 16 in
Prostate gland	6 drachms.		
Testicles (together)	¾ oz. to 11 ozs.		
Uterus (unimpregnated)	. . . .	7 to 13 drachms.	3 in. x 2 in. x 1 in.
Ovaries (together)	. . . .	120 to 200 gr.	
Bladder	. . . .	. . . .	Size subject to var Probably greate males.

CHAPTER XXI.

PRESUMPTION OF DEATH AND OF SURVIVORSHIP.

Presumption of Death—Cases involving this Question—Presumption of Survivorship—Cases involving Presumption of Survivorship—The French Law as contained in the Code Napoleon—Probabilities afforded by Age, Sex, etc.

THE question of **presumption of death** may arise in such cases where an individual leaves his home and is not heard of for many continuous years, and in some instances never again. The usual limit of time by statute is seven years; but where a person is known to have been alive during that period, the supposition is that he is still alive until his death is known to have occurred, or until the presumption of death is legally established. Hence this question must depend on general evidence, being a presumption of fact to be ascertained by a jury. Absence of an individual alone does not raise a presumption of his death; but such absence, in connection with surrounding circumstances, such as the failure by his family and friends to learn of his whereabouts, his character, and his business relations, together with the fact that he was last seen near the place where a murder is supposed to have been committed, and the belief in his family and circle of friends that he is dead, creates a strong presumption of death. The law, however, is satisfied with a less certainty, although a preponderance of proof is required to establish the fact. On the other hand, evidence to overcome the presumption of death—*i.e.*, that the party supposed to be dead was in a financial condition which might have induced him to abscond, or that he was a speculator, or visionary in his business—is all proper evidence to be considered by the jury in ascertaining and establishing the fact. (Sensendefer *vs.* Pacific, etc., Ins. Co., 19 Fed. Rep., 68.)

The question of the presumption of death may be raised in cases where heirship and property are concerned. The law will, in that event, presume the death of a person after the lapse of the necessary period of time established by statute, and direct the administrator or executor of such person to settle the estate.

In life insurance cases, where the insured party has been absent from his usual place of residence for a number of years, and where his lawful heirs demand the payment of his policy, the presumption of death is frequently a point at issue.[1]

In the case of married persons, a person cannot be convicted of bigamy if he or she can prove that his or her husband or wife has not been heard of for

[1] In cases where property was inherited, and in some cases of life insurance, courts have not considered it necessary to wait the lapse of the entire seven years before effecting a settlement; in some instances the lapse of two years was deemed sufficient.

a period of seven years by those who would naturally have heard of him or her had the party in question been alive.

In other cases of a special character, such as where the person concerned and presumed to be dead was afflicted with some affection or disease when last heard from, the courts have decided the presumption of death to be earlier or later than the allotted seven years, but the probable issue would involve the hearing of medical testimony as to the probabilities of life.

Presumption of Survivorship.—At one time it was said that where several persons have perished in the same catastrophe, the presumption was in favor of the survival of the stronger person; and again, many cases are to be found seeming to support the position that simultaneous death is to be presumed. But it must now be taken as the law that there is no artificial presumption in cases of this nature, either that any one in particular survived or that all died at the same time; and it will merely be considered, in the absence of evidence to the contrary, that one of them survived, leaving it to be discovered from the evidence who was the individual survivor. The question is one of fact, depending wholly on evidence, the real or supposed superior strength (as from age or sex) of any of the persons perishing by a common calamity being left merely to carry its natural weight,—*i.e.*, as a circumstance proper to be taken into consideration by a judicial tribunal, but which, standing alone, is insufficient to shift the burden of proof. The *onus probandi* is on the person who claims derivatively through a survivorship of one out of several to prove the fact affirmatively; and if the evidence does not establish the survivorship of any one, the law will treat it as a matter incapable of being determined. ("American and English Encyclopædia of Law.")

The decisions rendered by the courts of New York, Florida, Maryland, Maine, Colorado, and Kansas upon the presumption of survivorship are negative, every case in which the question is involved being adjudicated according to its individual merits, or through the ordinary agencies of proof. In California, however, when two persons lose their lives in the same calamity, and it is not shown who perished first, and there are no particular circumstances from which it can be inferred, survivorship is presumed from the probabilities resulting from the strength, age, and sex, according to certain rules, one of which is, if both be over fifteen and under sixty, and the sexes be different, the male is presumed to have survived. ("California Code of Civil Procedure," par. 1963, subd. 40.)

Cases involving Presumption of Survivorship.—Among questions upon this topic dependent upon a legal decision are such as, "When the parties dying are a father and a son, if the son survive but a moment, his wife shall have dower, for the lands descended the instant the father died." Again, "In the case of a testator and legatee, if the latter dies first, the legacy lapses; but if he survives the testator for ever so short a time, his executors can claim." So again, "The husband of a woman possessed of freehold property (not specially settled) has a life interest in her estate, pr

ded she has issue by him, born during the life of the mother, and which urvives her even for a moment of time (*tenancy by courtesy*)."

The old Roman law upon this subject enacted that when persons of ifferent ages perished, and there was no evidence presented to show which urvived, those under puberty were presumed to have died first; but if one person was above the age of puberty, and both perished together, it was presumed that the former survived the latter. In the case of husband and wife, the husband was presumed the survivor. (Beck.)

French Law of Survivorship.—This, according to Fodéré and Beck, is as follows:

1. If several persons, naturally heirs of each other, perish by the same event, without the possibility of knowing which died first, the presumption as to survivorship shall be determined by the circumstances of the case, and, in default thereof, by strength of age and sex.

2. If those who perished together were under fifteen years, the oldest shall be presumed the survivor.

3. If they were all over sixty years of age, then the youngest shall be presumed the survivor.

4. If some were under fifteen and others over sixty, the former shall be presumed the survivors.

5. If those who perished together were over the age of fifteen, but under sixty, the males shall be presumed the survivors where the ages are equal or the difference does not exceed one year.

6. If they were of the same age, that presumption shall be admitted which opens the succession in the order of nature. Of course, the younger shall be considered to have survived the elder.

By Section 4 in the above French Code there is no distinction made between an infant one year old and a man of sixty-one years of age, yet it may fairly be supposed that the man of sixty-one years had a better chance of life than the infant, nevertheless the advantage is given to the latter. (Tidy.)

The following points are of such importance (notwithstanding the fact that our laws relative to questions of presumption of survivorship are not decisive) that they are presented for the consideration of the court and those who have to discharge the duties of a jury:

I. *Probabilities afforded by the Age.*—(1) In the case of a father and of a child, the English civil law decides the former to be the survivor if the latter be under the age of puberty.

(2) There is no probability of survivorship afforded between the ages of fifteen and sixty.

(3) Between a middle-aged man and one under fifteen and over sixty years, the probabilities are in favor of the middle-aged man.

(4) In the case of one under fifteen and one over sixty years, the latter is supposed to die first.

(5) In the case of two under fifteen perishing, the oldest is considered the one who lives longest.

(6) Between a mother and infant, both dying in childbed, without assistance, the presumption of survivorship is in favor of the former,[1] because the child might be still-born, and also because, if large, its life might be endangered by delay, and it would be more exposed to danger without assistance. (Reese.)

II. *Presumption afforded by the Sex.*—In the case of a man and a woman perishing by the same casualty, the presumption of survivorship is in favor of the former when it is a question of physical strength and courage, although the question of health might have to be considered. When, however, the passive endurance of the party is considered, the presumption of death would be in favor of the woman.

III. *Presumption afforded by the Cause of Death.*—(1) In cases of *drowning* or *shipwreck*, the age, sex, strength, opportunity, and position must be considered. For example, as regards the sex, etc., a man, being stronger, and more likely able to swim than a woman, and in case of shipwreck being more apt to be on deck, and therefore in the best available position for relief or escape, has the better chances of escape, hence the best probabilities for survival. But, on the other hand, a woman's breasts and her clothes might buoy her up and support her in the water when her strength was fast waning. If the question of survivorship occurs in the case of two or more persons, equally exposed, the presence of bodily injuries or other weakening causes, together with their respective swimming capabilities, would have to be carefully noted. Again, the physician would have to consider whether the bodily injuries were inflicted when the person first fell into the water, or not; and further, Were the injuries the outcome of violent efforts to save the person's life?

(2) In death from *asphyxia* (apnœa), cold, heat, lightning, or starvation, the presumption of survivorship will be considered later on. (*Vide* Asphyxia, Cold, Heat, etc.)

If the question be on the survivorship in the case of several persons being *poisoned*, the medical jurist should consider the following,—viz., (1) the quantity of the deleterious substance ingested, and (2) the strength of the persons poisoned. It is, however, in such cases (as remarked by Tidy) that some definite law determining survivorship is required.

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[1] Tidy quotes the following cases from Zacchias, vol. i. pp. 440, 441: "First, of a mother and infant being shipwrecked; and the other of a mother and infant being killed by lightning, where the parents in both instances were deemed the survivors."

CHAPTER XXII.

PERSONAL IDENTITY.

ıe Identity of the Living—The Identification of the Dead: (I.) Of the Body recently Dead but Entire—(II.) In Cases where Mutilated Remains or a Portion only of a Body have been recovered—(III.) In Cases where a Body has been burnt —In Cases where the Skeleton remains, etc.—Tabular Statement.

By identity is meant the determination of the separate or distinct exence of a person, drawn from a series of facts, some of them obscured, rhaps, by trick or fraud, and all of them more or less varied by circumances. When the recognition of a person is the object of a judicial action, e forensic application of the term is to be considered. Medico-legally, the nsideration of personal identity is one of great importance, embracing, as does, questions which affect cases of both a civil and a criminal character; fact, it may constitute the most important evidence of any presented.

Cases of mistaken identity have frequently arisen, and medical literature irly teems with instances which go to show that innocent persons have ften been made to suffer because they had the misfortune to resemble thers.

The subject of personal identity will be considered under (1) *The Identity of the Living* and (2) *The Identification of the Dead.*

THE IDENTITY OF THE LIVING.

The identity of the living may usually be established by the direct evidence of those who have had such acquaintance with the person in question that they have a perfect recollection of his personal appearance. This kind of evidence is, however, often very defective, for the reason that instances do occur where the most confident identification of persons has afterwards proved to be of no value whatever. In the celebrated Tichborne[1] and Guerre cases illustrations are afforded of the extreme difficulty of deciding this question. In the former instance eighty-five witnesses swore that the claimant was Sir Roger Tichborne, even the latter's mother and family solicitor being among the number. The claimant's case, however, was lost on the cross-examination. The uncertainty of identification is also well shown in the Martin Guerre case, which was tried in the year 1560, before the Parliament of Toulouse. This personage had been away from his home for a period of about eight years, when an individual named Du Tilh appeared and represented himself as the long-absent man. So strong was the resemblance that his statement was universally accepted by all of Guerre's family,

[1] In this case a man named Arthur Orton, with various aliases, undertook to personate Sir Roger, heir to a large estate.

including his wife, sisters, and two brothers-in-law, among whom he had lived unsuspected for three years, having two children by Guerre's wife. Some circumstances, however, occurred to cause suspicion in regard to his true character, and he was arrested on a charge of fraud. Upon his examination he gave perfectly satisfactory answers to the most minute inquiries in relation to Guerre's former life. Some one hundred and fifty persons were examined during the proceedings, of whom between thirty and forty testified from a life-long acquaintance that the prisoner was Martin Guerre, while about the same number swore positively that he was Armand Du Tilh, whom they well knew ; and over sixty, who knew them both, declared that they were unable to say which the prisoner was. Finally, however, the real Martin Guerre appeared upon the scene, when immediately he was recognized by the four sisters who had previously testified that Du Tilh was their real brother ; they now admitted their error and acknowledged the distinction. There being now no doubt of the guilt of the prisoner, he was condemned to death and executed. (Wharton and Stillé's "Medical Jurisprudence," vol. ii. p. 1092.)

From these two most astonishing examples the fact is demonstrated that appearances are not conclusive evidences of personal identity, simply because they convey different impressions to different observers. This goes to show that a large proportion of people are untrained in minute observation.

A second means of establishing identification, especially in a criminal, is by (*a*) *size*, (*b*) *dress*, (*c*) *voice*, and (*d*) by the *presence of peculiar marks* (moles, scars, cicatrices, deformities, fractures, and tattoo marks).[1]

(*a*) *Size.*—This relates to the appearance of the person,—that is, whether he be very tall or very short, very corpulent or very slim, or whether he be lame or otherwise deformed.

(*b*) *Dress.*—This means is sometimes very accurate in establishing the identity of an individual, as where a portion of the prisoner's clothing is found retained in the grasp of his victim, or discovered in the vicinity where the crime was perpetrated.

(*c*) *Voice.*—The identification of an individual may be aided by certain peculiarities of the voice ; thus, a deep or shrill, lisping or stammering tone always makes an impression hardly forgotten by those who hear it.

(*d*) *Peculiar Marks.*—These may be either natural or acquired, and may form strong evidence in proof or disproof of identity. Moles are occasionally transmitted through several generations. Mother's marks are very common. "Many curious cases of doubtful or disputed identity might be cited to illustrate the singular fortuitous resemblance between individuals, not only in their general personal appearance, but also in accidental marks. Other cases might also be related in which long absence and various circum-

[1] Scars, cicatrices, deformities, fractures, and tattoo marks will be considered under The Identification of the Dead.

s have so changed a person that his nearest relatives have not been recognize him. Usually in cases of disputed identity, whether of the r living, a scar, a deformity, or some congenital or indelible mark, as *maternus*, or mother's mark, a mole, a tattooing, etc., has proved the eans of recognition."

lue of Professional Stigmata.—Under this head may be mentioned pearance of various marks upon the body of the suspected person, dicating the occupation of the person. For example, *washerwomen* a peculiar condition of the skin of the hands, swollen fingers, and ies occasioned by the exercise of pressure; the surgical condition as housemaid's knee results from kneeling a great deal. Cataract is ed to be more common among *jewellers*, as a result of the fineness r work. It is pretended that retraction of the last phalanx of the left is of frequent occurrence among this class of workers. A character-gn of the occupation of *drivers* and *coachmen* is the distinct spot of situated between the thumb and index finger, and between the and third and third and fourth fingers, of both hands. Among *akers*, etc., the skin of the index finger of the left hand will be found ough, thick, and blackened, being dotted with numerous points, the f needle punctures. This condition, however, appears in many occu-s. Among *violinists* there exists a hardness of the skin of the tips of gers of the left hand. A deep-brown discoloration is sometimes dis-e upon the hands of *curriers*, being due to their peculiar work of g. These spots turn to an almost black color if touched with a solu-prussiate of potash and iron. Besides these instances, others might ntioned, but the observer may gain considerable information as to the tion of an individual by noting carefully the appearance of the hands. Hamilton[1] quotes Le Grand du Salle as saying "that in four-fifths of rkmen he examined the hands showed the only trace of the kind of done." Tardieu has by the condition of the hands recognized the ng: laundresses, bleachers, copper-workers, coal-miners, coachmen, essers, tanners, cutters, hair-workers, nail-makers, porters, gilders, t-makers, clerks, florists, engravers upon metals, watch-makers, lock-, milliners, mother-of-pearl workers, shoemakers, glass polishers, -makers, rag-pickers, tortoise-shell polishers, bookbinders, grinders, -makers, stone-masons, drummers, dyers, wood-turners, metal-spin-ermicelli-makers, and glass-blowers. He divides the alterations of nd into those occupying the palmar portion, the fingers separately or er, the two hands, or one only. The right hand is that in which the ance is most marked, and when both are changed, that of the right rent from the left; and it is nearly always found that the fold of the in the palm has the greatest degree of epidermis thickening. When tire hand is the seat of alteration, according to Du Salle, we find that

[1] System of Legal Medicine.

this is the result of contact with some substance which produces a general alteration, as is the case with washerwomen, tanners, dyers, locksmiths, and saddle-makers. Changes in the feet are much more rare than elsewhere, but such changes are found among porters, tailors, and turners. Shoemakers, lace-makers, clock-makers, and shell polishers all present a change in the form, length, thickness, and wear of the nails, which signs are very characteristic. (*Identity of the Living*, Hamilton's "System of Legal Medicine.")

Hairs and Fibres.—(This will be discussed in detail in a separate chapter.)

The Determination of the Age.—The determination of the age of an individual during life is a matter of some difficulty, especially so in the case of adults. In children it may be necessary to *fix* the age, more or less precisely, "where the applicability of the laws of the Society for the Prevention of Cruelty to Children," or the question of *consent*, is at issue. The age of children is determined by noting the appearance of the teeth, the general development of the body, and the height and weight. The fact must not be overlooked that puberty may be somewhat retarded in cases of congenital or hereditary syphilis.

The successive appearance of the teeth, both of the first and second dentition, is shown in the following tables:

MILK TEETH.

AGE.	TEETH.
5 to 7 months	Central incisors.
6 to 9 months	Lateral incisors.
8 to 12 months	First molars.
15 to 18 months	Canine.
18 to 24 months	Second molars.

PERMANENT TEETH.

AGE.	INCISORS.		CUSPIDS.	BICUSPIDS.		MOLARS.		
Years.	Central.	Lateral.		Anterior.	Posterior.	Anterior.	Second.	Posterior.
7	.	.	.	.	.	4	.	.
8	.	.	.	.	.	4	.	.
9	4	4	.	.	.	4	.	.
10	4	4	.	4	.	4	.	.
11	4	4	.	4	4	4	.	.
12–12½	4	4	4	4	4	4	.	.
12½–14	4	4	4	4	4	4	4	.
18–25	4	4	4	4	4	4	4	4

Of course, it must be remembered that the time of the appearance of the teeth varies considerably in different children, and this is especially so in those of weakly, scrofulous, and rachitic constitutions. Again, there are others who have no teeth for several years, and still others who are born with the incisors above the gums.

The determination of the age of an *adult* is of extreme difficulty, on

account of the many changes, such as bodily decay, etc., which are constantly occurring in those who have been subjected to the usual routine of hard work, mental anxiety, and so on. Thus, the man of thirty or thirty-five may be made to look like a person of fifty, while the absence of any of these changes may cause the individual to appear much younger than he really is. Old age is by no means denoted by gray or white hair, and *vice versa*. Premature decay is often associated with those who have been the subjects of constant dissipation. Therefore, in determining the approximate age of a grown person, attention must be directed to the following points: (1) the nature and form of the lower jaw (inferior maxilla); (2) the condition of the teeth; (3) the rigidity of articulation; (4) the existence of friable bones; (5) the coldness of the extremities; (6) weakness of the genito-urinary apparatus; (7) troubles of excretion and circulation; (8) mental weakness; (9) presence of *arcus senilis*; (10) weakness of vision; (11) alteration in locomotion, etc. Tidy[1] says, "After thirty-five, besides the crafty crowsfeet (of which the laureate speaks) about the eyes, other lines make their appearance in the face, more especially around the mouth. The features become more set. The eyelashes, eyebrows, and hairs of the face generally grow coarser and longer. Hair, particularly in the male sex, grows profusely in the nostrils and ears and about the nipples. The thumbs become more pointed, and the great toe turns in a curved direction toward the middle line of the foot. The skin loses its suppleness, and becomes either drier or more greasy. The body may either fall away (sinking into little room) or grow stout. The abdomen often becomes pendulous, while in females the mammæ either waste or enlarge considerably. The arteries may become tortuous and cord-like, or of even bony hardness. An *arcus senilis* may be apparent in the eye. The figure begins to stoop as the intervertebral substance is absorbed or shrivels; the muscular power lessens, and the vertebræ become more bevelled. The teeth decay, the nose and chin approximate, and old age creeps on in the lean and slippered pantaloon."

Changes wrought through the Effect of Disease.—Facial changes are often, as is well known, occasioned by various general diseases. These changes may be so great that the identity of a person is completely lost. Among the affections that often produce startling results are certain atrophic conditions of the nervous system; therefore, the medical examiner must be on his guard when dealing with such cases.

Handwriting and Variety of Inks.—Handwriting as a means of identification may be of use in detecting the condition of the mind in certain individuals. The style and letter-formation of persons suffering from mental or other organic nervous affections are often greatly changed; in the insane, especially in the first stage of dementia, the handwriting is sometimes very characteristic. Rosse[2] mentions an instance, in the case of a former

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[1] Legal Medicine, vol. i.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

patient of his, an *aphasic*, who, being unable to express himself phonetically used a book and pencil, with the result that his writing showed a degree of *agraphia* sufficient to establish his identity beyond question. A fact of importance, not to be overlooked when considering the handwriting of persons is to determine whether the writing in question has been written with the right or the left hand. Some persons afflicted with writers' cramp are often enabled to operate with the unaffected extremity, a result brought about by constant training in this particular line.

In cases of suspected *forgery* or *erasure*, the chemist is frequently called upon on account of his special knowledge covering such cases. Evidences of identity are often furnished in cases of forgery by noting the similarity that frequently is found to exist between the variety of ink employed in a certain document and that discovered in the possession of a suspected person.

When the chemist is furnished with a document on which an erasure is suspected, he should note the following points before experimenting in any way with the paper: (1) the character of the paper, whether it is glazed on the surface only or all through; also whether it is hand or machine made; (2) the texture and water-marks; and (3) the character of the substance used to cover the erased spot; whether it presents a gummy or other consistence, etc.

The suspected paper should be subjected to a powerful lens in order to ascertain its transparency or translucency or any other peculiarities. The use of the microscope facilitates the demonstration of the water-marks and texture of the paper. Again, the comparative absorptive power of the suspected paper at the point of erasure and elsewhere may be determined by wetting it and placing it on a glass plate. In case the paper is unusually thick, paraffin, turpentine, etc., may be employed instead of water. Where animal gelatins, etc., have been used to cover the spot erased, certain reagents may be of service in detecting their nature; thus, when the suspected part is treated with a weak solution of iodine and starch, if animal gelatin is present, a blue color results. If gum were used, it would dissolve in water and be precipitated on the addition of alcohol. Resinoid bodies are dissolved by alcohol and reprecipitated by the addition of water. Remnants of the iron of the original ink employed, where an erasure has been attempted, may be detected by applying to the spot a solution of galls. The blue color of the iron inks will be revealed upon the application of a solution of the ferrocyanide of potassium. In cases where an acid has been employed to remove ink, litmus will be of use in affording detection. Solutions of ammonia are of service as a means of discovering the remains of any of the iron inks that have been bleached by acids. The color of the writing of most inks[1] will be destroyed upon the application of chlorine or solutions of the hypochlorites. (Tidy, "Legal Medicine," vol. i.)

Sympathetic inks are those preparations which, when used for writing,

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[1] Except those containing carbonaceous matter.

re no visible, or at least only colorless, marks upon the paper. These be revealed or brought out in colors by exposure to moisture or to , or by the application of other substances. When used separately, the rials of the ferro-gallic inks may be used as sympathetic ink, the writing done with the sulphate of iron solution and washed over with that of alls. A dilute solution of the chloride of copper used for writing is ble until the paper is heated, when the writing is seen, the color being utiful yellow, which disappears when the heat is withdrawn. Similar rties are possessed by the salts of cobalt, such as the acetate, nitrate, ulphate, the writing appearing in a bluish tint. They are rendered upon the addition of a salt of nickel. (*Vide* Table.)

ack Inks.—These contain gallate or tannate of iron, suspended by To prevent mouldiness, a few drops of creosote, carbolic acid, or substances (antiseptics) are added. Copying inks, such as are used to n impression of the writing made by them to another sheet of paper, e ferro-gallic inks, with a larger proportion of gum than they usually n, and a portion besides of sugar. Other inks are the so-called n (contains a little free acid), and those made from the extract of od mixed with chromate of potassium. Solutions of oxalic acid, ne, and hydrochloric acid will remove any of the inks referred to. ossibility of removal is prevented if Indian-ink is added.

e indelible inks are made by mixing a decoction of galls with vanadate monium, or by dissolving wheat gluten in vinegar, after steeping it in from twenty-four to thirty-six hours, and rubbing up the resulting with Indian-ink or lamp-black. This ink cannot be removed by ne, although the black color is dissipated. The silver inks are readily ved by the cyanide of potassium.

ue Inks.—The following formulæ are given by Tidy : Prussian blue, rts ; oxalic acid, 4 parts ; water, 1000 parts ; or, Prussian blue, 12.5 oxalic acid, 25 parts ; water, 1000 parts.

d Inks.—These inks may be made by boiling two ounces of Brazil half an ounce of alum, and half an ounce of crystals of tartar in six- unces of distilled water, until it is reduced one-half; after straining, n ounce of gum-arabic is dissolved, and a tincture added, made by ing in one and one-half ounces of alcohol (sp. gr. 0.839) one and one- rachms of cochineal. Another variety is made according to the fol- formula : Brazil wood, two ounces ; chloride of tin, one-half drachm ; rabic, one drachm ; water, thirty-two ounces ; this to be boiled down teen ounces. A third variety is made by boiling together to one-half, allons of good vinegar, two pounds of Brazil wood, and one and one- ounds of Roch or Rupel alum.

ther Inks.—Various different-colored inks are prepared by different ulæ, such as the yellow and green inks, etc. These latter contain a de- on of saffron and a solution of indigo carmine mixed with picric acid, ctively.

Printing-ink is a preparation very different from the inks used for other purposes. It is a mixture of boiled linseed oil, yellow soap, drying ingredients, and lamp-black. Sometimes ultramarine, vermilion, and lead chromate, respectively, are employed for blue, red, and yellow printing-inks instead of lamp-black.

Lithographers use an ink for tracing designs on paper, which are to be transferred to stone; and also an ink for taking impressions from engraved plates, which are to be transferred to stone. They are generally composed of shellac, soap, white wax, etc. There is little use for their description in this place.

TIDY'S TABLE OF SYMPATHETIC INKS.

INK.	DEVELOPER.	COLOR.
Solution of galls.	Dilute solution of an iron salt.	Dark brown or black.
Dilute solution of ferrocyanide of potassium.	As above.	Rich blue.
Chloride of cobalt.	Heat.	Blue. Color evanescent, but can be restored by heating.
Mixed chlorides of cobalt and nickel.	Heat.	Green. Color evanescent, but again appears with heat.
Dilute solutions of gold and silver salts.	Exposure to light and heat.	Brownish black or purplish.

WATTS'S TABLE SHOWING THE COMPOSITION OF VARIOUS INKS.

	INGREDIENTS PER 1000 PARTS.												
	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*
Galls	33	42	60	225	187	133	125	66	62	31	50	174	50
Green vitriol	75	73	55	24	22	31	19	32	87	16	20	21	11
Gum	25	73	55	24	19	31	8	9	43	47	20	16	11.5
Logwood	.	.	.	.	.	.	.	.	.	100	20	21	33
Vinegar	.	.	.	.	.	.	.	125	135	.	.	.	.
Sugar	.	.	.	.	.	.	.	.	.	23	10	16	.

The Limits of Sight and of Hearing.—The limits of healthy sight, unassisted by instruments, on a clear day and on level ground, are as follows: at a height of five feet the range of distance is 2.96 miles, at a height of twenty feet it is 5.91 miles, at a height of fifty feet it is 9.35 miles, at one hundred feet it is 13.2 miles, at five hundred feet it is 29.5 miles, at one thousand feet it is 41.8 miles, and at a height of five thousand feet it is 94 miles. Therefore, a man of ordinary height may be seen at a distance of from two to three miles, though recognition may not occur. Three essential requisites are necessary for the recognition of objects at the distances above stated; these are (1) *normal vision*, by which is meant that the sight of both eyes is perfect; the eyes must also be perfect in their power of discerning color; (2) *sufficient light;* and (3) *sufficient size of object.*

The recognition of a person at a nearer or greater distance depends

upon his stature, gait, color of hair, complexion, color of eyes, and peculiarities of appearance. According to Tidy, well-known persons cannot be recognized by *moonlight* farther off than sixteen or seventeen yards; in broad *daylight* at one hundred and nine yards; and by *starlight* the best-known persons cannot be distinguished at a distance greater than ten to thirteen feet. In some instances a *flash of lightning* may be sufficient to effect recognition. The light from a *pistol shot* may enable one to recognize the person using the weapon. From the many experiments carried on by Desgranges, of Lyons, the following conclusions were reached: "that on a very dark night, and away from any source of light, the person who fired the gun might be identified within a moderate distance. If the flash were very strong, the smoke very dense, and the distance great, the person firing the piece could not be identified."

De Gueret averages the results on the acuteness of vision as follows: at *fifty years* it is diminished one-fifth, at *sixty years* it is diminished one-fourth, at *seventy years* one-third, and at *eighty years* one-half; so that a person of thirty or forty years of age could identify an object at one hundred feet distance; at sixty years he could not distinguish it at a distance greater than seventy-five feet, and at eighty years he could not recognize the same object farther off than fifty feet.

The distance at which the report of a pistol or gun may be audible depends to a great extent upon the condition of the atmosphere,—moisture, direction of the wind, etc. The velocity of sound in the air averages eleven hundred and thirty-five feet per second, which is at the rate of about thirteen miles to the minute.

The limits of hearing are fixed by Savart as between eight complete vibrations per second and twenty-four thousand; by Helmholtz as between sixteen and thirty-eight thousand, or eleven octaves. The practical limit, however, as stated by Tidy, is between forty and four thousand vibrations per second, or a range of about seven octaves.

Bertillon's System of identifying Criminals.—The anthropometrical system, invented by M. Alphonse Bertillon, and adopted by the French government, is also in vogue in New York, Chicago, Boston, in various cities of Michigan, Ohio, Wisconsin, and of other States, and in the prison at Joliet, Illinois. The method of identification is based upon close attention to facial peculiarities that are not affected by time. Bertillon discovered that the dimensions of the head, the color of the eyes, and the shape of the ears or nose never changed, and although expressions may vary, the measurements never do. Thus by an ingenious method of tabulation he introduced a system which has baffled the efforts of old criminals to deny their identity when recaptured. Under this plan mistakes in identification are practically impossible. Of the five hundred thousand individuals who have been subjected to measurement by this system, no two have been found to be exactly alike.

The following *identification card* is a fac-simile of that adopted by the

French government, and is used for keeping *records* in the various pris of the country. Upon one side of the card are headings for name, bir place, occupation, pedigree of the individual, and a description of any m or wounds. On the reverse side of the card, in addition to the *profile* *full-face* photograph of the person, accurate measurements of his hei length and width of the head, length of the left middle and little fin of the foot, the forearm, the ear, the stretch of the arms, description of eyes, circumference of the bust, etc., are recorded. (*Vide* Table below.)

THE IDENTIFICATION RECORD.[1]

Height	Head: Length	Left foot ....
	Head: Breadth	Left middle finger ....
Stoop of shoulders	Right ear: Length	Left little finger ....
Spread of arms	Right ear: Breadth	Forehead: Inclination ....
Trunk	Aged	Forehead: Height ....
Color of left iris: Inner circle	Born	Forehead: Breadth ....
Color of left iris: Outer circle	At	Forehead: Peculiarities ....
Color of left iris: Peculiarities	Canton	Complexion: Color of ski
Nose: Root (cavity)	Department	Complexion: Full-blood or pale ....
Nose: Bridge base	Right ear: Rim	Corpulence ....
Nose: Height. / Projection. / Breadth.	Right ear: Lobe	Apparent age ....
Nose: Peculiarities	Right ear: Fold	Other characteristic features ....
	Right ear: Peculiarities	
	Beard	
	Hair	

PHOTOGRAPH. *Profile.*	PHOTOGRAPH. *Full face.*

No. .... | ....

.... | Surname and given names ....

Aliases .... Born .... , at ....

Son of .... Profession .... Last residence ....

Papers of identity .... Relations .... Military service ....

Number of previous convictions .... Cause and place of previous detention ....

.... Cause of present detention, detailed specification of crime ....

PECULIAR MARKS AND SCARS.

I	II	III ....
IV	V	VI ....

[1] *Vide* Preface.

Rosse[1] says that "the measurements, which can be made by any person average intelligence in three or four minutes, are extremely simple. The *ht* ear is always measured, for the reason that this organ is always reproced in the traditional photograph which represents the right face. Other ecial measurements are taken on the left side. . . . It is contended that these measurements alone the identity of an individual whose face is not en known may be established in another country by telegraph. The apication of the system has proved of great service in the apprehension of serters from the United States army (when the authorities have been able find the card), while it is claimed to have caused the disappearance of imerous dissimulators of identity in the prisons of Paris. . . . To avoid a *ssible source of error*, mensuration of the organs and the ascertainment their form may be resorted to in the case of a cadaver that is much deyed, or in one that has been purposely mutilated or burned by the assassin order to prevent recognition. A sufficient number of cases may be cited which the measurement of a limb or a bone of a deceased person known have been lame or deformed during life has resulted in the establishment identity or the reverse."[2]

Finger and Foot Impressions.—The value of imprints made by the nger- or thumb-tips, as a means of establishing the identity of an individual, as first pointed out by M. Francis Galton. His attention was first drawn this subject in 1888, when preparing a lecture on personal identification r the Royal Institution, which had for its principal object an account of the en new anthropometric system. He studied the various striations of the iman fingers, and was able to corroborate the value attributed to them as a eans of personal identification. The markings of a finger of Sir William erschell made in 1860, 1874, 1885, and 1888, respectively, are figured, and ow a striking similarity. The difference in age of the digit marks testifies the wearing of the epidermis.

So far as the proportions of the patterns go, they are not absolutely ted, inasmuch as they change with the shape of the finger. According as

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

[2] The Bertillon system, as adopted by the Police Department of New York City, somewhat of an improvement over that used in foreign countries. For example, uch greater accuracy is secured in the measurement of the height of the person under rrest. By the old method the height of the individual was secured by having him easured standing. By this method any clever person could alter it by simply flexing is muscles, whereby the difference in measurement might be so much as half an nch. Under the new order of procedure the measurement is secured by having the riminal laid flat upon his back, with his head and heels in contact with metallic lates so arranged that when the contact is perfect a signal is given by the play of lectric bells. In this way the record is infallibly accurate. Besides this modification, ther measurements are taken, as those of the head, the bones of which are subject less alteration than those of other parts of the body. In addition, imprints of the et are made on charcoal paper, and greater attention is paid to the measurements of e ears and of the occipital angles.

the finger is plumped out or emaciated, or variously deformed by usa gout, or age, the proportions of the patterns will vary also. Two prints the same finger, one taken before, another after, an interval of many yea cannot be expected to be as closely alike as two prints made from the sa wood-cut. At different periods of time the measurements vary, even in adult person, just as much as his height, span, and the length of his seve limbs. On the other hand, the numerous bifurcations, origins, islands, a enclosures in the ridges that compose the pattern are proved to be alm beyond change. To demonstrate the difference existing between prop tions and patterns, a comparison is made between the pattern on a finger a one on a piece of lace ; the latter may be stretched or shrunk as a whole, l the threads of which it is made retain their respective peculiarities and int relations. The evidence on which these conclusions are founded is mai derived from the collections made by Sir William Herschel. They refer one or more fingers, and in a few instances to the whole hand, of fifteen ferent persons. The intervals before and after which the prints were tak amounted in some cases to thirty years. Some of them reach from bal hood to boyhood, some from childhood to youth, some from youth to vanced middle age, and one from middle life to incipient old age. Th four stages nearly include the whole of the ordinary life of man. Altoget Galton has compared some seven hundred points of reference in th couplets of impressions, and found only a single instance of discordance, which a ridge that was cleft in a child became united in later yea ("Finger Prints," London, 1892.) Further illustrations are afforded Galton's book, of photographic enlargements which include between then total of one hundred and fifty-seven pairs of points of reference, all be ing distinctive numerals to facilitate comparison and to demonstrate th unchangeableness. Reference is also made to another publication of t author, which raises the aggregate number of points, photographically co pared, to three hundred and eighty-nine, all of which experiments were su cessful, with the single exception mentioned above. This observer, therefo holds that the fact of an almost complete persistence in the peculiarities in t patterns formed by the ridges, from birth to death, may now be consider as determined. They existed before birth, and they persist after deat until effaced by decomposition.

A fixed and constant series of patterns is found. M. Galton shows h systems of parallel ridges sweep in strong curves over the palmar surface the hand, and how, whenever the boundaries of two systems diverge, t interspace is occupied by a compact little system of its own, variously curv or whorled, having a resemblance to an eddy between two currents. interspace of this kind is found in the interspace of each finger. The ridg run in parallel lines across the finger up to its last joint, beyond which t insertion of the finger-nail causes a compression of the ridges on either sid their intermediate courses are in consequence so much broadened out th they commonly separate, and form two systems with an interspace betwee

A classification of the principal varieties of patterns is into arches, loops, and whorls. In the arches there is no pattern, for there is no interspace; in the loops the interspace is occupied with a system of ridges that bends back upon itself, and in which no one ridge turns through a complete circle. Whorls comprise all cases in which at least one ridge turns through a complete circle, and they include certain double patterns which have a whorled appearance. A third method of classification is determined by the origin of the ridges which supply the interspace from the thumb side or the little-finger side. ("Finger Prints," Galton, London, 1892.)

Hamilton[1] says, "For the establishment of the identity of a criminal a careful examination should be made of the papers handled, window-panes, and china and glass ornaments, or, in fact, any other object which may receive an impress from his more or less greasy fingers at the place of commission of the crime. By oblique light there will sometimes be no difficulty in finding upon the polished window-pane a faint though perfect imprint, which can afterwards be strengthened and made the subject of a permanent record. For this purpose the method contrived by Forgeot (publications of the Laboratoire d'Anthropologie Criminelle, of Lyons), which consists in the application of common ink or some aqueous pigment which will adhere to the parts that are not greasy, may be tried; or the glass may be subjected to the vapor of hydrofluoric acid. Forgeot has shown that even pieces of paper which have been touched by slightly greasy hands will bear the imprint of the fingers, and the most delicate markings may be brought out after treatment with ordinary ink, and these used as a negative with good results. In exceptional cases the finger-marks may be made to give lithographic impressions."

In the trial of Gurney, of the American Express Company, at New Orleans, the identity of the prisoner was established by the expert, through a faint impression of his thumb left in the wax of a broken seal and compared with a subsequent impression of the thumb. Photographs of the thumb impressions on the seal were made and enlarged. The thumb impression which had been made by Gurney was also enlarged; they were identical. Nevertheless, the prisoner was acquitted.

The value of *footprints* as a means for the identification of criminals is fully recognized, and may alone lead to the identity of such individuals. Mascar, of Belgium, and Causse, of France, differ as to the value of such impressions; the former holding that the impression of the foot in the ground is smaller than the foot that made it, while Causse, on the contrary, insists that the impression is usually larger.

The following remarks are abridged from Tidy's "Legal Medicine." The impress of a foot in sand, etc., is usually smaller than the foot producing it. This is due to the particles of sand at the margins of the impress, which partially fill up the space previously occupied by the foot. In the case of

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[1] System of Legal Medicine.

clay, or other like material, the impress is larger than the foot, for in the act of walking the foot is lifted from the ground in an opposite direction to that in which it was placed upon it. Again, the impress will depend on the shape of the boot, shoe, slipper, or even the naked foot itself. Further, the size of the impress will depend on the rapidity of progression. Thus, the impress of a naked or shoed foot, produced by a person running, is smaller than that of the same person walking. In the case of a person standing, the impress will be larger. Therefore, from the depth and extent of the marks thus made it may be possible to determine whether the person was standing, walking, or running. In walking, the mark of the whole foot is more or less discernible, as in standing; while in running, or in ascending a hill, the mark of the heel will be less distinct, although the mark of the ball of the foot may be very evident.

Peculiarities of gait may affect the character, shape, and size of the impression made by the foot. Thus, in a case mentioned by Tidy, the person had a peculiarity in moving the heel as soon as the foot reached the ground. Even otherwise trifling peculiarities are of importance in comparing footprints, as they may constitute valued evidence.

The impress of a naked foot covered with blood may lead to important discoveries. The following tabular arrangement, by Tidy, furnishes the rules to be followed and the questions to be considered in the examination of footprints, etc.

(1) Note any special peculiarities in the conformation of the foot; for example, bunions, etc.

(2) Note any special peculiarities in the boots supposed to have been worn when the impressions were made,—*e.g.*, unusual pieces of iron, nails, and any parts of the soles or heels worn away, indicating peculiarities of tread, etc.

(3) *Question.*—Do the impressions appear to correspond with the boots said to have been worn? (Be careful not to be misled by comparing a right-handed boot with a left-handed impress, or *vice versa*. Specially compare all peculiarities.)

(4) Note (*a*) the material on which the impressions occur,—*e.g.*, sand, clay, etc.; (*b*) the exact shape of the impressions. Is the heel well formed or not? Endeavor from this to draw some conclusion as to whether the person was standing, walking, or running. Note any signs in the footprints indicating peculiarities of gait. (*c*) The level of the ground on which the impressions occur.

(5) If there be any marks of blood on the ground, do they correspond or not with marks found on the soles of the boots?

(6) Take, if possible, casts[1] of the impressions for evidence. Preserve the blood-stains, or take impressions of them on paper.

[1] In taking a mould of a footprint, the method of Hougilon (which is applicable to all kinds of imprints except those in snow) may be resorted to. This consists in

(7) Note all the surroundings of the footprints, such as stains, weapons, etc., and their position in relation to the footprints.

The question as to the length of time since the footprints were made will depend upon various circumstances, such as the weather, temperature, etc.

"Circumstances sometimes direct expert attention to vestiges of other animals. The tracks of a dog or of a horse may become the object of a medico-legal inquest. The books record a case in which it was necessary to ascertain whether a bite had been made by a large or a small dog. This question was settled by producing the dogs and comparing their teeth with the scars. Persons familiar with border life know the importance of trails and the minute observation that is brought to bear on them by the experienced frontiersman. In following cattle thieves and murderers, while with the Fourth United States Cavalry on the Rio Grande frontier, I have known the peculiarity of a horse's footprint in the prairie to tell a tale of great significance. Observation in this respect may extend to such trivial objects as the tracks of wheels, as those of a wagon, a wheelbarrow, or a bicycle, or to the singular imprints left by crutches or a walking-stick. The imprint left in the ground by a cane usually occurs in the remarkable order of every two and a half or every four and a half steps. Investigation of such circumstances may result in material facts that may be of great assistance in establishing the relation of one or several persons with some particular act." (Rosse, in Witthaus's "Medical Jurisprudence, Forensic Medicine, and Toxicology.")

THE IDENTIFICATION OF THE DEAD.

I. Of the Body recently Dead but Entire.

In cases where a body has been dead a short time only, identification may be established by the same general methods as have already been referred to in the identity of the living. Other points to be considered are as follows:

Race.—Where the body is but recently dead and but partially decomposed, no great difficulty will be experienced in determining the race of an individual. The following brief summary of the four great families is taken from Harris's article, "Death in its Medico-Legal Aspects," in Hamilton's "System of Legal Medicine."

"(1) *The Australoid type*, such as the coolies in Southern India and the native Australians: skin chocolate-colored, hair black and wavy, the skull

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applying heat (to 220° F. or more) to the impressed ground by holding over it a benzine lamp, and then dusting the heated impression with ground paraffin. When cool, the latter may be removed for a mould of plaster of Paris, etc. For the reproduction of imprints left upon snow, common salt is sprinkled over the impress, followed by melted gelatin. The salt lowers the temperature of the snow about fifteen degrees, thereby allowing the mould to form solidly. The gelatin negative is removed and used to make on white plaster an exact representation of the imprint.

narrow or dolichocephalic, the brow ridges prominent, with a projecting or prognathous jaw and thick lips; the nasal index platyrrhine.

"(2) *The Mongolian type*, which includes the Chinese, the Japanese, and the American indigenes: skin from yellowish brown to a mahogany tint, the skull broad or brachycephalic, the hair black and straight, the brow ridges not prominent, the jaw not projecting except in the Esquimaux, the nose mesorrhine, small and flat in the Japanese and Chinese, with oblique eyes, and the cheek-bones high. In some of the American Indians the nose is prominent, but, as we are dealing with such peoples as are commonly met with, it is not necessary to do more than specify the typical features of the main group.

"(3) *The Negroid type:* the skin dark brown to black, the hair black, crisp, or woolly, the skull dolichocephalic, the brow ridges not prominent, the jaw prognathous, with fleshy, protuberant lips, the nose and nasal bones flat, the index being platyrrhine.

"(4) *The Whites*, divided by Huxley into the Xanthochroi, or fair whites, with pale skin, fair, wavy, or curly hair, light-colored eyes, mesocephalic skull, jaw orthognathous, and nose leptorrhine; and the Melanochroi, or dark whites, the complexion darkening to a sallow or swarthy hue, the hair dark, and the eyes brown or black; the skull mesocephalic, with orthognathous jaw and leptorrhine nose." (*Vide* The Skeleton, at end of chapter.)

Note should also be made of the shape of the nose, the color and size of the eyes, the curve of the lips, the shape of the ear, etc. The length and general appearance of the nails should also be carefully recorded. (The color and character of the hair, etc., will be discussed in a separate chapter.)

Tattoo Marks.—The identity of a suspected person may often be determined by such marks or inscriptions. Tattoo marks may sometimes be accidental,—that is, where various coloring materials find their way into a wound. In gunshot wounds, when the weapon has been held near the person, minute and scattered dots of powder may be found in the skin. Again, it frequently happens in coal-mine explosions that minute particles of the dust, etc., are forcibly driven into the skin. Tattoo marks are found mostly among criminals of the recedivist and instinctive type; also among women of easy virtue, pæderasts, and tribases. The designs are nearly always of an obscene nature; thus, it may be possible to determine the calling or previous life of a person by suggestive initials or inscriptions.

The indelibility of tattoo marks is such that they may be recognized in the dead body, even when the latter is in a state of decomposition. Tardieu states that extensive tattoo marks may be got rid of; while Taylor, on the other hand, is of the opinion that they cannot be effaced. "Caspar found that, out of thirty-seven persons examined, the marks had become effaced in six; Hutin, of five hundred and nine examined, disappeared in forty-seven; Tardieu, of seventy-six examined, effaced in three,—over nine per cent. of the whole. In the famous Tichborne trial, evidence was given

hat both Roger Charles Tichborne, the heir, and the man called Arthur Orton had been tattooed. Now, Tichborne's tattoo was R. C. T., and Arthur Orton's was A. O. On the arm of the claimant there were no tattoo marks at all, but there were two round, depressed scars on the left wrist about the size of a shilling, and suggestive of the tattoo marks as A. O. These scars had evidently been produced by escharotics. Of course, excision of tattooed wounds is an easy possibility." (Hamilton.)

It is well to recollect, in connection with these marks, that otherwise invisible tattooing may be rendered apparent by briskly rubbing the suspected skin.

Cicatrices, etc.—The identity of an individual may sometimes be determined by an examination of a cicatrix or scar. (This subject will be more fully discussed when the subject of Wounds is considered.)

Other points to be remembered in this connection are the depressions made upon fingers by rings, or upon legs by garters, as they may resemble slightly superficial scars.

The value of photographing the remains of a dead person cannot be questioned, not alone in the case of the whole body, but also where portions of a corpse are found at different intervals, since the question may arise whether they belong to the same individual or not.

II. In Cases where Mutilated Remains or a Portion only of a Body have been recovered.

The difficulty of identification is very much increased in those cases where the body of a person has been subjected to mutilation after death, or where severed portions of the same body have been removed to a distance or even destroyed.

Murderers often dispose of the mutilated remains of a dead body with a view to escape detection. In the brutal murder of his mistress, Cæsar, the New York negro, who was recently convicted and sentenced to death, mutilated the remains in a horrible manner, and then removed the severed portions to a distant part of the city, for the evident purpose of avoiding the suspicion that was soon cast upon him.

In addition to the foregoing remarks (see also the Identity of the Skeleton) on the identity of the entire body recently dead, the following case, which came under the observation of Dr. Hebbert, of London, is quoted from Dr. Harris's contribution to Hamilton's "System of Legal Medicine," vol. i. ("Death in its Medico-Legal Aspects"), and will serve to illustrate many of the important points which the medical examiner must note,—to wit:

"In July, 1887, Mr. Bond was requested by the treasury to examine some remains found in various portions of London, and I had the opportunity of helping at the autopsy. All the portions were found either in the Thames or in the Regent's Canal, and consisted of eight separate parts. In the inquiry we had to determine the following points: whether they were human and belonged to the same body, the race, age, sex, height,

complexion, and condition of life, and, if possible, the cause of death and the skill or ignorance of the operator.

"The parts were: (*a*) the lower part of the thorax and the upper part of the abdomen, from the fifth dorsal vertebra to the third lumbar vertebra; (*b*) the pelvis below the third lumbar vertebra; (*c*) the right thigh, including patella; (*d*) the left thigh; (*e*) both legs and feet, the left having patella attached; (*f*) the arms from the shoulders to the fingers. They were obviously human, and on applying the various joint and bone surfaces together we found that they fitted. The skin-cuts apparently corresponded, but had been too much altered by decomposition to warrant a certain opinion. The limbs were muscular, and the remains generally had a fair amount of subcutaneous fat.

"The various parts were then described in the report. First, the thorax had been cut above through the body of the fifth dorsal vertebra, and below through the body of the third lumbar vertebra, the bones having flat but somewhat rough surfaces, and through the skin and other tissues by a series of more or less clean-cut incisions, so that the fourth left rib and the fifth right rib had been left, and the sternum below the articulations of these ribs. The diaphragm was intact, but the lungs, heart, and other thoracic viscera were absent. Below the diaphragm were the liver, stomach, both kidneys, and spleen; the remaining viscera of the abdomen were included in the pelvis below the third lumbar vertebra.

"The lower piece of the trunk was the abdomen from the third lumbar vertebra and the pelvis. No part of the small intestine from the duodenum was found, nor the large intestine, except the sigmoid flexure and rectum in the lower fragment. In the pelvis were the uterus, vagina, ovaries and appendages, and the bladder. The acetabula were empty, the thighs being separated from the pelvis by incisions passing around the flexure of the joint. The external organs of generation were those of a female. The uterus measured three and one-eighth inches, the body one and one-half inches, and the cervix one and five-eighths inches. The os internum was well marked and the arbor vitæ very distinct. The os externum was small and would barely admit the point of a sound. The ovaries were small, and one showed a corpus luteum of menstruation. The rugæ of the vagina were prominent. On the pubes were some black hairs. An incision had evidently been made from the ensiform cartilage to the pubes. There was no trace of ecchymosis in the skin of the incisions separating the limbs or those dividing the trunk.

"The skin of the two pieces of the trunk was partly decomposed and sodden, but was evidently fair in color.

"The arms had been taken off at the shoulder by incisions passing obliquely downward and outward from the tip of the shoulder around the axilla, so as to leave most skin on the upper and outer aspect of the arm. The heads of the humeri had been cleanly disarticulated. The skin of the arms was peeling off, and that of the palms thick, white, and sodden; the

two terminal phalanges of the fingers, with the exception of the thumb and the left ring-finger, had rotted off. The length of the left arm and hand was twenty-five and three-eighths inches. There was no circular depressed mark on the left ring-finger.

"The thighs had been cut off at the hip-joint by cuts around the flexure of the joint, and the heads of the femora disarticulated. The right thigh had the patella attached, but was separated from the leg at the knee-joint. The left thigh, which was found at a later date, showed not only more signs of decomposition, but the head of the femur was riddled with the small circular holes of a water-worm. The femur measured sixteen and one-eighth inches from the head to the lower level of the internal condyle.

"The legs, including the feet, had been cut off by circular cuts from the centre of the knee-joints, the left leg having the patella attached. The legs were well-shaped and muscular, and the foot small and without deformity. There were circular, slightly depressed marks, about half an inch deep, just below the knee. Each leg with the foot measured sixteen inches, right and left tibiæ thirteen inches, right and left fibulæ thirteen inches. The skin of the legs and thighs was decomposing, the cuticle in places being raised in bullæ and peeling off. The cuticle of the feet had disappeared with the nails, and the terminal phalanges had fallen off.

"The following inferences were then drawn from the foregoing facts:

"1. *The sex* was easily told, as the external organs of generation, as well as the uterus and ovaries, were present.

"2. *The Age.*—The union of the epiphyses proved the age was over twenty-five.

"3. *The complexion* was dark, as shown by the pubic hair, while the fair skin proved Caucasian origin.

"4. *Height.*—The length of the arm being twenty-five and three-eighths inches, by doubling this and adding twelve inches for clavicles and sternum, we should have a result of five feet two and three-quarters inches. The length of the lower extremity was thirty-two and one-eighth inches, multiplied by two would equal sixty-four and one-quarter inches,—*i.e.*, five feet four and one-quarter inches. By measuring the ring-finger the length was three and one-quarter inches; this multiplied by nineteen would give us five feet one and one-quarter inches; so we had to average the three measurements and calculate her as about five feet three inches in stature.

"5. *Condition of Life.*—The skin of the hands and feet was too much decomposed to show whether she had led a life of hard manual work. There was no mark made by a wedding-ring. The uterus was that of a virgin, but the vulva was too decomposed to give indication with regard to old or recent injury. The mark around the leg showed that garters were worn below the knee,—a custom, I believe, more common among the lower than the upper classes, who either wear garters above the knee or suspenders. She had recently menstruated.

"The cuts on the surface of the vertebra were such as would be made by

a saw, and the long, clean, sweeping incisions through the skin showe a very sharp knife had been used. The disarticulations were neatl cleanly done, in each case the joint being exactly opened. The abse ecchymosis showed that all the cuts were made after death.

"It was obvious, from the direction and manner of the cuts, th ordinary surgical or dissecting-room operation had been carried Although no special knowledge of anatomy was shown, the cuts indic practical skill in amputating limbs at joints and making clean sweeping cuts. It may be argued that such skill may be gained by a hunter butcher, as either of these are in the habit of rapidly and skilfully sepa limbs, and of cutting up a trunk into several parts. I do not think th surgeon or anatomist could have done the work so well, as they are no *stantly* operating, while a butcher is almost daily cutting up carc Moreover, the limbs were separated in almost precisely the way a butc hunter would adopt,—*i.e.*, making a series of cuts around the flexure joint, and then, by a strong twist, wrenching out the head from the and cutting the capsule.

"The condition of the skin showed that each part had been lyin decomposing in water, and that several months had elapsed since th of death.

"The summary was that the remains were those of an adult fem Caucasian origin and dark complexion, from twenty-five to thirty-five old, and about five feet three inches high; that she had not borne a and, in fact, from the small size of the os uteri, was unlikely to conc that the body had been mutilated *after* death by some person who, th not necessarily a skilled anatomist, yet had some knowledge of joint the readiest mode of separating limbs, and by inference a butcher or hu that decomposition had taken place in water, and some months had el since death." (*Vide* Tabular Statement at end of chapter.)

III. The Identity of Burnt Remains.

One of the most difficult problems submitted to the medical exami the determination of the identity of burnt human remains. Neverth if the burnt bone be entire, the state of the epiphyses may *clear u* question of the determination of age. In the case of calcination, the ence of lime phosphate in the ash would constitute no evidence of the being that of a human being, since the bone-ash of other animals is iden The following case, in which the body of a man was almost inciner shows how the recognition of even minute portions of bone may lead t identification of a person.

A fireman employed in the engine-room of a coal-pit was mis Blood being discovered on the door of the furnace, together with portions of dress proved to belong to the dead man, suspicion arose he had been foully dealt with and his body submitted to the action o fire in the furnace. A physician examined the ashes of the furnace

found portions of the occipital bone and the base of a human skull, together with the fangs of an incisor and molar tooth. Continuing the search, he discovered portions of the arches of the dorsal vertebræ, a part of the lumbar vertebræ, a portion of a head, body, and humerus, and part of the head and joint of the femur. These bones had been subjected to a high temperature, which had destroyed their internal structure, but the external form was well preserved. A chemical and microscopical examination of some of the clinkers showed that there was blood upon them having the character of human blood. There was no doubt that these were the remains of the missing man. He was last seen alive at eight o'clock in the evening, and at four o'clock the next morning nothing remained of him but the few bones referred to above. (Taylor.)

THE IDENTIFICATION OF HUMAN BONES.

In cases where the question of identity relates to isolated bones or to the entire skeleton, the highest anatomical skill may be requisite before a satisfactory answer can be given. The following points will suggest themselves in the course of the examination: (1) Whether the bones submitted for inspection belong to a human being or one of the lower animals. (2) If they belong to a human being, whether male or female. (3) The length of time they have probably remained in the ground. (4) The probable stature of the person during life. (5) The probable age of the person to whom they belonged. (6) The race to which he or she belonged. (7) It should be determined whether solitary bones belong to the right or to the left side, and whether they form parts of one or more than one skeleton. (8) Whether they have been fractured, and, if so, whether it occurred during life, or by accident at the time of the exhumation. If it occurred during the life of the person, whether it be recent or of long standing. (9) The presence or absence of deformities, of supernumerary fingers or toes, of curvature of the spine, of ankylosis of one or more joints. (10) Whether they have been calcined. (Taylor.)

Age in the Dead.—In determining the age, the progress of ossification in the different bones, and in young persons the development of the teeth, are the best guides. Of course, it must be remembered that in the identification of detached bones, or of the entire skeleton, the determination of the age is only approximative. In a case mentioned by Tourdes, the age of a deceased person was guessed as between sixty and sixty-five, whereas the person was eighty-five. Therefore the exact age is difficult to state with any degree of certainty.

The following *résumé*, chiefly from Semple, shows the extent to which osseous union has progressed: The separate bones of the skull are generally united within a year or so after birth; but occasionally the two halves of the frontal bone remain separate throughout the natural period of life. The cranial bones become thinner in old age, as the diploë is more or less absorbed. The sutures at this time of life become ossified, and, if very indis-

tinct, the age may be approximated at from fifty to sixty years. At about the age of puberty the parietal sutures disappear, although they may remain separate during life. The arch and body of the *vertebræ*, together with the body and odontoid process of the axis, unite about the third year, while ossification does not begin in the epiphyses of the spinous and transverse processes until about the age of puberty. They join the vertebræ at the age of twenty-five years, or sometimes later. Separation of the several vertebræ of the sacrum continues until eighteen years of age, at which period they commence to unite from below upward, the process not being completed until the age of twenty-five or even later. At a later period the coccyx becomes united to the sacrum. The epiphyses and shafts of the *ribs* are not united until the age of twenty-five. In the *sternum* the five segments of the bone are not united until the age of puberty, when it takes place in the lower segments. The body and manubrium of this bone are not joined until old age, but the upper segments unite from the twenty-fifth to the thirtieth year of age, or later. Union takes place in the various ossific centres of the *scapula* from the twenty-second to the twenty-fifth year. The sternal epiphysis of the *clavicle* appears from the eighteenth to the twentieth year, although its junction to the shaft of the bone is not apparent until the age of twenty-five. The head and tuberosity of the *humerus* become united at the age of five years, and are joined to the shaft at twenty years. From the sixteenth to the eighteenth year the condyles unite with the shaft. The superior epiphysis of the *radial bone* joins the shaft at from the seventeenth to the eighteenth year, while the lower epiphysis unites with the shaft at twenty years of age. The osseous union of the *ulna* is similar to that of the latter bone. Of the metacarpal and phalangeal bones, the epiphyses join with their shafts at about the twentieth year. The three portions of the *os innominata* unite about the seventh or eighth year, although they can still be separated. At about the twenty-fifth year the os innominatum is completely ossified. The head and shaft of the *femur* join at about the eighteenth or nineteenth year, the lower epiphysis and the shaft continuing separate until the twentieth year. Before puberty the neck of this bone has an oblique direction, forming a slight curve from the axis of the shaft. In the adult male and female there is a difference in this direction; in the former it forms an obtuse angle with the shaft of the bone, while in the latter it approaches more nearly to a right angle. It has a horizontal direction in very old and greatly debilitated subjects. The lower epiphyses and shaft of the *tibia* unite at the eighteenth or nineteenth year, while the upper epiphysis joins with the shaft in the twenty-first or twenty-second year. The same parts of the *fibula* unite at a somewhat later period. Of the *metatarsal bones*, the epiphyses and shafts unite at a period of from the eighteenth to the twentieth year, and those of the phalanges somewhat later.

In *advanced life* the cartilages of the larynx and ribs become ossified to a certain extent,—that is, their structure assumes more the appearance of osseous than of cartilaginous tissue. By some observers this ossification

particularly of the ribs, is regarded as a sign of disease rather than of age. (Humphry.)

Other points worthy of note in connection with old age are the approximation of the osseous laminæ of the flat bones as a result of the absorption of the osseous plates of the cancelli. In consequence, further, such bones (ilium, scapula, etc.) are rendered lighter and more brittle. They assume a yellowish color, and their aspect and touch are greasy, through the more or less infiltration of free fat. In the vertebral column the bodies of the several vertebræ are bevelled off in front, and the *column* bends forward. Shrivelling in the intervertebral disks also takes place during this period of life.

In the *lower jaw*, however, age produces the greatest structural changes. At a very early period of intra-uterine life and in early infancy the ramus and body of the inferior maxilla form an exceedingly obtuse angle; in middle life a right angle is almost formed; while in advanced age, after the disappearance of the teeth and absorption of the alveolar border, a reverse order to the infantile type occurs, a prominent ridge replacing the sockets for the teeth as they originally existed. (*Vide* Identity of the Living.)

Sex.—In the matter of sex there should be no great difficulty, as this can usually be determined from the skeleton, if complete. In cases where single bones and the entire skeleton are submitted for examination, it is well to remember that up to the age of puberty there is little or no difference discernible in the general characteristics of the sexes, although there are many exceptions, of course, in which the males have the advantage both in height and weight.

The bones of the male are generally larger and stronger than those of the female; but the thorax of the latter is deeper and the costal cartilages longer. In short, the corresponding bones of the two sexes differ in size, weight, and the prominence of their ridges and protuberances. There is also a certain difference in the bones of the head. Thiem-Cottbus[1] advances the following craniological criterion of sex: "The os tympanicum forms part of the posterior wall of the glenoid cavity of the inferior maxillary bone, and also closes in front and below the bony meatus of the ear. It arises perpendicularly from the petrous portion of the temporal bone posteriorly, and turns backward, in women at about half the height of the mastoid process, but in man at a less height. In the male the bone develops a sharp edge, which divides to form the sheath of the styloid process; but in woman this sharpened edge does not exist, the bone is rounded into a tubercular form, and the fossa is shallower and flatter. Thus, in the male, this fossa-tympanico-stylo-mastoidea is small and the posterior wall of the glenoid cavity extends so deep that it is not possible for the condyloid process to slip over it. In the female it is so much more spacious that this feature alone will serve to distinguish the skulls of one sex from the other."

It is in the pelvis, however, that the main characteristic distinctions are

[1] Archiv für Klinische Chirurgie, Band xxxvii.

observed. The male pelvis is deeper and narrower than that of the female. Its bones are thicker and its muscular impressions well marked. In the female the ossa ilii are more expanded and flatter, and therefore more capacious at the superior portion. The sacrum is more concave, being broader and turned farther backward, while the pubes is shallow and wider. The greatest diameter in the male is the antero-posterior; whereas, in the female, the bilateral is the greater. The foramen ovale is egg-shaped in the male; in the female it is triangular. The acetabula are farther apart in the female. All of these appearances, it must be remembered, are not exhibited until the age of puberty is reached. The following table, after Tidy, shows the measurements of the male and female pelvis.

Measurements.		Male.		Female.				
		Inches.	Lines.	Inches.	Lines.		Inches.	Lines.
Between the antero-superior spinous processes of the ilia		7	8	8	6	to	10	0
Between the middle points of the cristæ of the ilia		8	3	9	4	to	11	1
The transverse	diameter of the abdominal strait of the true pelvis.	4	6	5	0	to	5	6
The oblique		4	5	4	5	to	5	5
The antero-posterior		4	0	4	7	to	4	4
The transverse	diameter of the cavity of the true pelvis.	4	0	4	7	to	4	8
The oblique		5	0	5	2	to	5	4
The antero-posterior		5	0	4	7	to	4	8
The transverse	diameter of the perineal strait of the true pelvis.	3	0	4	0	to	4	5
The antero-posterior		3	3	4	4	to	5	0

Race.—The principal differences of race are most manifest in the skull, the chief characteristics of which are indicated in the following classes:

1. *The Prognathous Skull of the Negro.*—The chief peculiarity in this form of skull is the characteristic extension or projection of the jaws. The so-called facial angle of Camper is about seventy degrees. The situation of the foramen magnum is generally far back, and the shape of the nasal opening is an equilateral triangle.

2. *The Pyramidal Skull of the Esquimaux; also of the Inhabitants of North and Central Asia.*—This skull is pyramidal in shape, due to the form of the malar bones. In reference to this point, Rosse[1] says that "the books usually speak of the Esquimaux skull as pyramidal, which, in point of fact, is not true. Inspection and examination of a large collection of Esquimaux crania has changed and greatly modified some of the previous notions of the conventional Esquimaux skull. From more than one hundred, collected in the vicinity of Behring Strait, I find that the skulls present very considerable variations among themselves, some being brachycephalic, others dolichocephalic. In many the facial angle is eighty degrees, and in one instance eighty four degrees, which exceeds that observed by me in many German skulls. Nor is the prominence of the zygomatic arches such a constant

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

nce in the configuration as to justify one in speaking of the skull as ıidal. On the contrary, in many specimens lines drawn from the most ting part of the zygomatic arch and touching the sides of the frontal instead of forming a triangle on being elongated, might, like the ɔtotes of a parabola, be extended to infinity and never meet. The of the foramen magnum in these skulls is about the same as that of ɔean crania. The internal capacity shows marked difference, the cubic nts of the endocranium averaging that of the French or German."

The Oval Skull of the Indo-European or Caucasian.—The facial angle : skull of a European varies from eighty to ninety degrees. Great caution be exercised in drawing conclusions from the shape of the skull alone. ı addition to the characters of the skull, other parts of the skeleton be examined if possible. Thus, in the negro, the feet are very broad at, the backward prolongation of the os calcis being very great. "In ing the osseous system it should be remembered that certain modifying nts, as artificial compression, pathological deformities, posthumous dis- ns, and hygrometric conditions, may affect particularly the skull, and : allowance be not made for these the study may lead to glaring absurdi- (Rosse.)

ıe following table by Ward shows the relative capacity of the skull in ːnt races :

RACE.	WEIGHT OF SKULL WITHOUT LOWER JAW, OZ. AV.	WEIGHT OF MILLET SEEDS THE SKULL WILL HOLD, OZ. AV.
ı { 1	26.00	42.50
2	20.60	31.50
e { 1	34.50	37.25
2	27.00	39.25
an { 1	40.25	34.00
2	32.00	35.75

ıe subjoined tables, by Dr. Humphry, give the measurements of human ːons of different races, etc., the first table in inches, and the second ed to a scale of 100 :

:E, ETC.	HEIGHT.	MIDDLE POINT OF SKELETON.	LENGTH OF SPINE.	CIRCUMFERENCE OF SKULL.	HUMERUS.	RADIUS.	HAND.	FEMUR.	TIBIA.	FOOT.	PELVIS. Antero-posterior Diameter.	PELVIS. Transverse Diameter.
ɔean (av- ge of 25)	65	Symphysis pubis	22.2	20.5	12.7	9.2	7.3	17.88	14.4	10.60	5.2	4.3
) (aver- of 25) .	62	1 in. below symphysis	19.3	19.8	12.1	9.4	7.7	17.00	14.4	11.11	4.6	4.1
sman (av- ge of 3) .	54	Symphysis	17.0	19.6	10.8	8.3	6.0	15.00	12.9	7.50	4.4	3.5
(in Berlin seum) .	57	Symphysis	19.5	13.5	12.0	8.8	7.0	16.00	12.5	8.50	5.0	3.8

Race, etc.	Height.	Length of Spine.	Circumference of Skull.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Pelvis. Transverse Diameter.	Pelvis. Antero-posterior Diameter.
European . . .	100.00	34.15	31.54	19.54	14.15	11.23	27.51	22.15	16.03	8.00	6.61
Negro	100.00	31.13	31.94	19.52	15.16	12.42	27.40	23.23	17.90	7.42	6.61
Bosjesman . .	100.00	31.48	36.29	20.00	15.37	11.11	27.78	23.89	13.78	8.15	6.48
Idiot	100.00	34.21	23.68	21.05	13.43	12.28	28.07	21.92	14.96	8.94	6.66
O'Byrne, 8 feet 2 inches . . .	100.00	30.61	23.98	17.35	13.26	10.41	24.69	21.43	12.75	6.94	6.33
Irish giant, 8 feet 6 inches .	100.00	33.04	33.83	16.86	13.23	10.10	24.70	20.90	11.57	8.33	4.45
Sicilian female at 10, 20 inches	100.00	31.00	70.00	17.50	13.00	11.00	25.00	17.50	14.00	7.00	7.50
Bebe (or N. Perry) at 23, 3 feet	100.00	. .	. .	22.23	13.60	. .	26.39	19.45	. .	8.63	6.67

Stature.—If the whole skeleton is laid out, the original height may be determined by allowing one and a half to two inches for the soft parts. Reese,[1] quoting M. de St. Lucca, says, "There is a general proportion between the different bones of the body and the stature, and that an approximate estimate of the stature may be had by measuring the length of the first phalanx of the middle finger, thus: this phalanx is equal in length to one-fourth that of the whole hand, including the carpus; and the carpal and metacarpal bones together represent one-half of the hand. The arm may be divided into five parts, of which two are included in the humerus, two in the forearm, and one in the hand. The total length of the hand is, therefore, one-fifth of the arm. Double the length of the arm (or the two arms stretched out horizontally), added to the length of the two clavicles, together with the transverse diameter of the sternum, is equivalent to the whole length of the body."

Ordinarily, the top of the symphysis pubis is the centre of the body in the average woman, while in man the centre is below the symphysis. According to Quetelet, the length of the foot equals that of the head, and a little more than one-ninth of the body in man. Dwight assumes that the total height of the intervertebral cartilages is twenty-five and six-tenths per cent. of the entire length of the spinal column. In Orfila's tables, given below, the stature is calculated from the length of bones, the measurements being given in inches and fractions of an inch.

Length of Bone (Inches).		Stature.		
		Maximum.	Minimum.	Difference.
Humerus (19 observations)	14.50	68.10	64.50	3.60
Ulna (14 observations)	10.66	70.80	65.66	5.14
Femur (12 observations)	17.75	69.66	64.50	5.16
Tibia (11 observations)	14.21	69.66	64.50	5.16

[1] Medical Jurisprudence and Toxicology.

Length of Bone (Inches).		Stature.		
		Maximum.	Minimum.	Difference.
Humerus (6 observations)	13.00	73.25	69.75	3.50
Ulna (7 observations)	10.66	73.25	65.00	8.25
Femur (7 observations)	18.10	72.00	67.00	5.00
Tibia (7 observations)	15.00	70.50	65.00	5.50

The question, *How long have bones been buried?* may arise in medico-legal inquiries, but the reply at most can only be approximative. Much will depend upon the condition of the soil in which they have been buried. Thus, in a dry soil they will resist decomposition for a period of from thirty to forty years; and if preserved in crypts, etc., they may not be affected for hundreds of years. Taylor states that the bones of William Rufus were discovered in a stone coffin at Winchester, almost perfect, after a burial of seven hundred and eighty years.

During the process of decay bones become lighter in weight as a result of the loss of animal matter; the external color assumes a darker hue, and the ends, becoming gradually brittle, crumble away and, together with the shaft of the bone, are reduced to ashes (dust). It is stated that so perfect were the bones of Abelard and Heloise, after the lapse of five hundred years, that the female skeleton could easily be distinguished from that of the male.

To determine whether exhumed bones are old or recent, every little detail should be noted with great accuracy. Thus, the discovery of the periosteum and spinal marrow would be proof of a recent state, etc. It requires a lapse of about ten years for a cadaver to skeletonize, although the resistance to decomposition may last for a long time.

"The trade or occupation leaves but few marks on the bones that are useful in the matter of identification. . . . As a rule, the relatively larger scapulæ point to the fact of a day-laborer; necrosis of the lower jaw suggests a worker in phosphorus; worn and discolored teeth, a user of tobacco; and aurification of the teeth might suggest the previous social condition. Gold crowns and fillings and dental prosthesis generally are among the most common and, at the same time, among the most useful signs of identification. By this means the bones of persons killed by Indians on the Western plains have been recognized years afterwards. The traveller Powell, massacred in Abyssinia, was recognized in this way. From the presence of artificial teeth and the mechanical appliances for fixing them, dentists may recognize their own work beyond a doubt. One of the most common-hackneyed of these cases is that of Professor Webster. Later cases, in which this kind of proof established convincing and conclusive identification, are those of Dr. Cronin, assassinated in Chicago in 1889, and of the bomb-thrower, Norcross. . . . In every important case a cast of the mouth should be taken, in order to set at rest any question that may subsequently arise as to the condition of the

jaw, the absence of teeth, their irregularity, or other dental peculiarities. (Rosse.)

Other means of identification are afforded by congenital peculiarities, deformities, fractures, and other injuries. Hereditary or acquired disease of the bones, such as rickets, spinal disease, caries, necrosis, ankylosis, etc., may also furnish sufficient evidence to reconstitute individuality. It is well to remember, however, that post-mortem lesions made at the autopsy of a body are not impossible. Again, the effects of violence apparent in exhumed bones may be the result of the spade of the grave-digger.

TABULAR STATEMENT OF DETAILS TO BE NOTED IN THE EXAMINATION OF PERSONS, OF BODIES OR PARTS OF BODIES, OR OF BONES IN THE QUESTION OF IDENTITY.

(*After Tidy.*)

I. General Observations.

1. The Surroundings of the Body.

Note.—(1) Clothes.
(2) Jewelry.
(3) All articles found on the body or in the coffin.
(4) Hairs grasped in the hands or free about the body.

2. The Probable Business or Trade at which the Person worked.

Note.—(1) Condition of the hands, whether horny or soft.
(2) Any special injuries to nails.
(3) Any special stains, as silver and dye stains, etc.

3. The Height of the Person.

4. The Weight of the Person.

5. The Probable Age of the Person.

Note.—(1) The amount and color of the hair.
(2) The teeth.
(3) The maxillæ; condition of the alveolar processes.
(4) The condition of the fontanelles.
(5) The centres of ossification.
(6) The condition of the epiphyses.
(7) The size of the bones.

6. The Sex.

Note.—(1) The genital system.
(2) The condition of the breasts.
(3) The general conformation.
(4) The length of the hair and its nature generally.
(5) The pelvic bones.
(6) The markings on the bones.

7. Deformities.

Note.—(1) Shortening of legs from hip-disease, etc.
(2) Spinal disease.
(3) Talipes.
(4) Large wens, etc.

tc., on the Skin.

:.—(1) Marks on the skin may include tattoo marks, scars, signs of former disease, etc.

(2) Distinguish between those arising:

(*a*) From disease, such as scrofulous ulcers, small-pox, diseased teeth, syphilis, etc.

(*b*) From operations (major operations; also bleeding and cupping, leech-bites, etc.).

(*c*) From tattooing or flogging.

(*d*) From natural causes (discoloration, nævi, moles, warts, etc.).

(*e*) From violence.

(*f*) From such stains as blood, etc.

'e.—(1) Fractures.

(2) Dislocations.

(3) Wounds. Consider: (*a*) their probable origin; (*b*) position; and (*c*) extent.

:xamine in detail the various parts and organs of the body, as

ad.

te.—(1) Complexion; fair, dark, sallow.

(2) Shape of head, etc., and features; European, Mongolian, etc.

(3) Forehead; low, high, prominent.

(4) Eyes; large, small, sunken, prominent.

(5) Nose; short or long, flat and broad, broad or well-formed nostrils, etc.

(6) Ears; lobules well formed, or continuous with the cheeks; pierced or not.

(7) Mouth; large or small; note scars on the roof; condition of alveolar processes.

(8) Lips; large or small. Cicatrices.

(9) Teeth:

Number.

Regularity.

State of decay.

Any special parts where they are more than usually worn.

Whether there are false teeth, or indications exist of their having been worn.

(10) Chin; full, round, double, pointed, or receding.

(11) Hair; amount, color, and length on head, lip, or chin. Test, if necessary, to ascertain whether the color be natural; whether it has been recently cut.

ck.

te.—Its characters; short or long; thick or thin; cicatrices.

est.

te.—(1) Formation; well formed or pigeon-shaped.

(2) Shoulders; high or sloping.

(3) Sternum; flat, sunken, etc.

13. The Pelvis.

Note.—(1) The genitals ; normal or otherwise.
(2) In females the question of pregnancy.
(3) In the case of a skeleton, decide whether the pelvis be that of a male or a female.

14. The Extremities.

Note.—(1) The arms. Size and length generally. Observe whether the fingers are short or long, and whether they are of proper proportional length. Any peculiarities of the nails.
Note whether the hands are roughened or not by hard work, and whether marked or not by stains.
(2) The legs ; whether uniform or not in length.
Ankylosis of the joints.
Whether bowed or not.
Whether in-kneed.
The ankles and feet.

II. Mutilated Remains.

In addition to what has already been stated, note the following :

1. Degree of Accuracy of the Fitting of the Various Parts, as follows :

(1) Bones.
(2) Muscles.
(3) Blood-vessels.

2. Nature of the Mutilations :

(1) Whether the soft parts were divided with a blunt or a sharp knife, with or without skill.
(2) Whether the bones have been chopped or sawed with a coarse or fine saw.
(3) The after-treatment to which the parts have been subjected: whether they have been acted upon by lime or other chemicals. Burning : If the bones be entire, examine as usual; but if an ash only be found, examine this for phosphate of lime. Boiling, etc.

III. The Skeleton or Individual Bones.

In addition to the points already indicated, note :

(1) The extent to which the soft parts have disappeared.
(2) The extent to which separation of the bones has taken place.
(3) The color of the bones; their state of preservation; whether human or not.
(4) The sex.
(5) Whether the bones belong to the same body or not.
(6) Examine the pelvis and surrounding parts for the remains of fœtal bones.
(7) Whether any evidence of disease of the bones exists, such as spinal disease, rickets, syphilis, etc.
(8) The existence of injuries.

(Blood-stains, seminal spots, etc., will be treated of later ; also the Infantile Skeleton.)

CHAPTER XXIII.

HAIRS AND FIBRES.

Their Structure—Effects of Reagents on Hair—Medico-Legal Questions connected with this Subject—The Hairs of Different Animals—Tables.

HAIRS are epidermic appendages; in reality, modified skin formations. Each hair consists of an assemblage of epidermic cells at the bottom of a bulbous-shaped follicle in the substance of the skin, which is supplied with nourishment by blood-vessels distributed to its walls. It is composed of a root, from which the hair is developed, and a stem or shaft continuous with it. The root is that portion above the bulb and within the follicle. Under the microscope two structures are visible,—the cortex, cortical, or outer portion, which is fibrous in structure and dotted or striated in appearance, and the median (inner) portion, the pith or medulla, which consists of granular nucleated cells containing air. These latter are from $\frac{1}{1000}$ to $\frac{1}{2000}$ inch in diameter, and are angular or rounded in form, being arranged linearly. The air contained in the cells referred to causes them to appear black by transmitted light and white by reflected light. The tubular appearance of hair under the microscope is due to the effect of refraction, and disappears when the hair is soaked in a caustic soda solution previous to the microscopic examination. Human hair may be divided into three varieties,—(1) long, soft hairs from the head (one to three or more inches in length); (2) short, rigid, and thicker hairs (one-fourth to one-half an inch in length), such as are found in the eyelashes; and (3) short and very fine hairs from the face, back, and extremities (one-twelfth to one-sixth of an inch in length). A cuticular coat of flat epithelial cells surrounds each hair. The well-marked characteristics of the latter, as observed in different animals, depend, to a certain extent, on the arrangement of this cuticular investment.

The diameters and lengths of hairs from different parts of the human body, as well as from different persons (male and female), vary greatly. Thus, the hairs from the head are usually finer, longer, etc., in the female than in the male, and in children they are softer and finer than those obtained from grown persons. According to Pincus, the length of the hair from the head is from twenty-two to thirty-one inches, and the rate of growth during the first two years from one-twelfth to one-fifth of an inch; the diameter averages about $\frac{1}{350}$ inch in man, and $\frac{1}{450}$ inch in woman. The following comparative diameters of the hairs from different positions

medico-legal importance, however, can be attached to these meas since hairs from the same locality are subject to too great variatio as the identification of their locality is concerned ; nor can any re be drawn between the appearances presented by a single hair and th of the person to whom it belonged. (*Vide* Table.)

The question, *Is a certain substance presented for examination h it some fibre, etc., not hair?* is of forensic importance ; therefore t scopical and chemical peculiarities of various fibres, etc., likely to founded with hair will be outlined, as follows :

(1) *Cotton.*—This is the hairs from the epidermis of certain see cotton fibre is in the form of a flattened band of a twisted or spiral s due to the collapse of the cells when dried. It is not colored by test liquid.[1]

(2) *Wool.*—This fibre is irregular, wavy, and of unequal thickne found in certain of the Ruminantia. It is a variety of hair. The t markings on the fibre are very large.

(3) *Linen.*—This consists of round fibres, with jointed transver ings at unequal distances, tapering to a point. It is the liber fibres from the stems of the flax plant. They show a very oblique a striation when boiled with nitric acid. Linen is not colored by th mentioned test.

(4) *Silk.*—This is obtained from a substance secreted by the organs of the silk-worm. The fibres are cylindrical in form, and al from any markings. They refract light very powerfully. Upon mi examination they exhibit solid and somewhat flattened fibres, the bo of which are well marked. Millon's test colors silk.

(5) *Hemp.*—This is the liber fibres of the Cannabis sativa. Its semble those of flax (linen), but are coarser. Boiled with nitric a swell and become brittle, but exhibit no spiral streaks.

(6) *Jute and Bast.*—The former is from an East Indian plant (C capsularis), while the latter is the liber of the lime-tree. They both vegetable structure, their fibres being of a long and glossy nature, w ends. Their walls are not as thick as those of flax fibres, and whe with nitric acid no spiral streaks are exhibited.

(7) *Coir.*—The fibres of this material are found in the form of

[1] A strongly acid solution of the mercuric and mercurous nitrates. It t red.

t ends being characteristic of each fibre. No markings are exhibited, when boiled with nitric acid no spiral streaks are noticeable.

The Hairs of Animals.—These are, as a rule, thicker, shorter, and ser than those of the human being. The hairs of all animals possess the ntial parts of cortex and medulla, however much they may differ in eral appearance. In some animals, particularly the smaller rodents, the ical tubular portion is crossed by transverse partial or complete parons, while in others the essential structure does not differ from the finest l. The greater part of the diameter of the shaft of animal hairs may be upied by the medulla, so much so that the cortical portion can hardly be ected. This is an important point of difference, since the resultant jointed earance of the cuticle, in some cases, marks the differences existing ween such hairs and the fine downy ones of man and of the fœtus. rther, the medullary substance of the hair of man may be absent, or, if sent, it represents but a small proportion of the total diameter of the ft; while, as has been mentioned above, the medulla is almost always stant in the hairs of animals.

In cows, horses, the deer, etc., microscopic examination generally reveals true nature of the hair; but in some animals—the sky-terrier and spaniel, example—the distinctions are not so marked, since the hairs bear a close emblance to those of man. In the reindeer and the musk-ox the entire r-substance seems to be made up of delicate polygonal cells.

In distinguishing the hairs of man from those of an animal the following ints are to be remembered: the size, shape, and microscopical appearces, the locality of the pigment, the relative proportion of medulla and rtex, and the arrangement of the medullary cells. (Tidy.) The hairs of man ve a much finer appearance than those of any other animal; besides, the nsverse lines of the cortex are more marked. The size of the hair of the rse and the deer is greater than that of man, with a relatively greater delopment of the medulla. The locality of the pigment, both in man and the monkey, is confined to the cortex, while in the rodent it is found the medulla. The medullary air-cells in the hair of man are smaller and re crowded than in the quadrumana. The following diameters of hairs m different parts of the body are expressed in fractions of an inch:

DIAMETERS.

Down from a suckling	$\frac{1}{3333}$ to $\frac{1}{260}$
Hair from a young girl's arm	$\frac{1}{6666}$
Hair from the head of a female	$\frac{1}{434}$
Hair from the pubes of a female	$\frac{1}{166}$
Hair from the head of a man	$\frac{1}{333}$
Hair from the pubes of a male	$\frac{1}{233}$
Hair from the beard	$\frac{1}{166}$
Hair from the eyelashes of a male	$\frac{1}{666}$
Hair from the arm of a man	$\frac{1}{1000}$ to $\frac{1}{666}$
Hair from the hand of a man	$\frac{1}{370}$

DIAMETERS—Continued.

Hair from the moustache	$\frac{1}{360}$ to $\frac{1}{151}$
Hair from the ears	$\frac{1}{535}$
Hair from the eyebrows	$\frac{1}{360}$
Hair from the nostrils	$\frac{1}{313}$
Hair of deer	$\frac{1}{360}$
Hair of horse	$\frac{1}{340}$
Hair of fox	$\frac{1}{560}$
Hair of dog	$\frac{1}{1100}$
Hair of rabbit	$\frac{1}{1125}$
Hair of goat	$\frac{1}{500}$
Pig's bristle	$\frac{1}{100}$

The following table by Oesterlen furnishes the average diameters of medulla and shaft in different kinds of hair (the originals have been redu to fractions of an inch).

AVERAGE DIAMETERS OF THE MEDULLA AND SHAFT IN DIFFERENT KINDS O HAIR.

LOCATION OF HAIRS.	MEDULLA.	SHAFT.
MEN.		
Top of head	$\frac{1}{4233}$	$\frac{1}{423}$
Crown of head	$\frac{1}{2540}$	$\frac{1}{470}$
Temple	$\frac{1}{1814}$	$\frac{1}{364}$
Forehead	$\frac{1}{2117}$	$\frac{1}{376}$
Eyelashes	$\frac{1}{6350}$	$\frac{1}{501}$
Eyebrows	$\frac{1}{2540}$	$\frac{1}{604}$
Moustache	$\frac{1}{794}$	$\frac{1}{353}$
Axilla	$\frac{1}{3175}$	$\frac{1}{351}$
Pubes	$\frac{1}{1693}$	$\frac{1}{336}$
WOMEN.		
Top of head	$\frac{1}{3628}$	$\frac{1}{501}$
Crown of head	$\frac{1}{2117}$	$\frac{1}{353}$
Temple	$\frac{1}{1058}$	$\frac{1}{355}$
Forehead	$\frac{1}{3175}$	$\frac{1}{470}$
Eyelashes	$\frac{1}{2309}$	$\frac{1}{364}$
Eyebrows	$\frac{1}{1814}$	$\frac{1}{423}$
Axilla	$\frac{1}{1693}$	$\frac{1}{355}$
Pubes	$\frac{1}{2117}$	$\frac{1}{281}$
OLD MAN.		
Top of head	$\frac{1}{2117}$	$\frac{1}{426}$
Crown of head	$\frac{1}{2117}$	$\frac{1}{376}$
Temple	$\frac{1}{1814}$	$\frac{1}{423}$
Forehead	$\frac{1}{2309}$	$\frac{1}{281}$
BOY (aged fifteen years).		
Top of head	$\frac{1}{2117}$	$\frac{1}{426}$
Nape of neck	$\frac{1}{2540}$	$\frac{1}{426}$
Crown of head	$\frac{1}{2309}$	$\frac{1}{423}$
Eyebrows	$\frac{1}{2309}$	$\frac{1}{476}$

GE DIAMETERS OF THE MEDULLA AND SHAFT IN DIFFERENT KINDS OF HAIR—*Continued.*

LOCATION OF HAIRS.	MEDULLA.	SHAFT.
y (aged one and one-half years).		
d	$\frac{1}{3133}$	$\frac{1}{681}$
BOY (aged six months).		
. . . .	$\frac{1}{3540}$	$\frac{1}{552}$
ANIMALS.		
lly	$\frac{1}{635}$	$\frac{1}{323}$
ck	$\frac{1}{529}$	$\frac{1}{363}$
oodle	$\frac{1}{3175}$	$\frac{1}{1016}$
orse, back	$\frac{1}{363}$	$\frac{1}{323}$
orse, belly	$\frac{1}{706}$	$\frac{1}{508}$
orse, back	$\frac{1}{635}$	$\frac{1}{318}$
orse, belly	$\frac{1}{727}$	$\frac{1}{426}$
. . . .	$\frac{1}{564}$	$\frac{1}{391}$
lly	$\frac{1}{976}$	$\frac{1}{426}$
ck	$\frac{1}{976}$	$\frac{1}{663}$
ly	$\frac{1}{3540}$	$\frac{1}{1693}$
k	$\frac{1}{426}$	$\frac{1}{338}$
ack	$\frac{1}{529}$	$\frac{1}{479}$
elly	$\frac{1}{552}$	$\frac{1}{462}$
e	$\frac{1}{4233}$	$\frac{1}{3175}$
arse	$\frac{1}{1411}$	$\frac{1}{1058}$

cts of Reagents on Hair.—Nitrate of silver blackens hair, form-lphuret. This substance and sulphur form the bases of most of the es in use. Acids cause the hair to appear rough ; and while alkalies similar effects, they have the power of restoring the color of hair d by acids. Another effect of the alkalies is their power of dissolving Alcohol adds transparency, while chlorine water or the gas causes to decay with more or less disintegration. A greenish tint of the frequently a result observed in indigo-workers and ebony-turners. oticed, quite often, a bluish-green tint of the hair of copper-smelters. le of hydrogen is commonly used to dye the hair a golden tint. Light hair may be darkened by the employment of the common hair-dyes, re principally composed of the salts of silver, lead, and, more rarely, . In hair thus colored the metal may be discovered readily by it with nitric acid, and testing the solution by the appropriate es. To effect this, the hair is first washed in an alkali, to remove asy matters. It is then soaked in chlorine water, its tint being lightened, but the hair is rendered brittle.

dico-Legal Questions.—These are : (1) *Is the hair human or not ; rom what part of the body?* Upon microscopic examination this n may be answered, since the differences in the cells and linear mark-the cortical portions of the hairs are made apparent. The following

outline gives the chief characteristics of hairs from various parts of the
The second part of the question under consideration should be rep
with extreme caution.

LOCATION OF HAIRS.	GENERAL CHARACTERISTICS.
Hairs from the eyebrows	Firm at the point; bulb stout and kn On section they are smooth, angular,
Hairs from the eyelashes	Roots spindle-shaped and short colored
Hairs from the nose and ears	Roots stout, the structure of the hairs coarser than those of the eyelashes.
Hairs from the beard and moustache	Triangular on transverse section; shavi cutting modify the shape.
Hairs from the axilla	The shafts do not taper; points are coni not sharp; perspiration modifies the and lightens color of hair.
Hairs from the back of hand	Modified by friction and soap, which al to fray them. Roots club-shaped.
Hairs from the pubes	Oval and flattened; may also be rough; male the roots are generally knotty, the female they are broader.
Hairs from the scrotum	Long in old persons.

(2) *If the hair is human, does it correspond with that of the murde that of the victim?* This question involves the size, color, and character hairs in such comparisons. Tidy[1] says, "The observations, to be val should be numerous. Correspondence, the result of a single observ should not be deemed sufficient to prove identity, any more than non- spondence in a single observation should lead us to assert non-identity giving evidence it will be safer to say that two hairs are similar tha they are identical."

(3) *Is the hair that of a male or of a female person?* The hair of is shorter, and from $\frac{1}{2500}$ to $\frac{1}{3000}$ inch greater in diameter than that of fe The roots are from $\frac{1}{800}$ to $\frac{1}{500}$ inch wider, and they are not so easily af by alkalies. (*Vide* Tables.)

(4) *If a hair be not human, from what animal has it been derived* cases of bestiality this question may arise; also where hairs are foun bedded in blood-stains, or discovered on a weapon supposed to have c death. (*Vide* Tables, etc.)

(5) *Has the hair in question been lately cut or shaved; or, if free, has i pulled out forcibly, or did it fall out spontaneously?* To ascertain wh the hairs were cut off, attention should be directed to the appearance fragment toward the root; also whether the root is absent. Cut hair

[1] Legal Medicine.

regains its tapering condition, being more or less rounded. If the ends are smoothly cut, it is probable that a sharp instrument was employed; but if they appear jagged, the hairs were either cut with a dull instrument or broken off. Hairs forcibly pulled out appear crushed and frayed, the sheath being torn away with the bulb, although it is extremely difficult to decide whether such hairs were pulled out or fell out spontaneously. The hair frequently falls out after certain diseases, such as febrile affections, especially typhoid fever, or erythematous affections of the scalp. Irritating applications to the head often occasion a loss of hair, and the present fashion of wearing tightly fitting and unyielding hats no doubt contributes largely toward the premature fall of hair. In such cases the bulbs of the hair are often diseased, although Tidy states that "the appearance of hairs lost after fevers and other acute diseases closely resembles, as regards the conditions of their bulbs and hair-sheaths, those torn out violently."

(6) *Has the color of the hair been naturally or artificially changed?* The hair of old persons naturally turns gray, but this change may be hastened by disease or shock, as from sudden fright or grief. The hair of children grows darker as they advance in life. The hair may also be dyed so as to obscure identification. Occasionally a man from thirty to forty-five years of age appears grayer than one ten or more years older. The following case illustrates how the hair may be discolored so as to interfere with identification: "A man named Benoit was arrested on suspicion of murder. Some witnesses testified that they had seen him in Paris at two in the afternoon, with black hair, while others declared that they saw him at Versailles with fair hair at five or six of the evening of the same day. The question being proposed whether it was possible to change the color of the hair from dark to light, Orfila deposed that it was. He made numerous experiments to show this, from which it resulted, that by washing the hair with solutions of chlorine, black hair could be changed to various lighter shades, according to the strength of the solution and the length of time that it remained applied. This mode of discoloration can, however, readily be detected by the peculiar smell of the chlorine, and by there being something unnatural in the color resulting from its application. He found also that the most effectual way to darken hair naturally light was by the employment of a compound of litharge, chalk, and fresh lime in nearly equal parts. After the hair, which has been wetted with a solution of these materials, has become dry, the chalk and oxide of lead remaining attached to the hair are removed by weak acetic acid and cleaned with the yolk of an egg. The hair is thus effectually dyed black, without any injury to its texture. The fraud can, however, easily be detected by steeping some of the hair in dilute nitric acid, which dissolves the ingredients with effervescence, and, on testing the solution with hydrosulphuric acid, the black sulphide of lead will be obtained."[1] (*Vide* Effects of Reagents on Hair.)

[1] Wharton and Stillé's Medical Jurisprudence.

In all artificially colored hair the fraud can be detected by observing the new growth, which will usually present a different color.

(7) *May the hair grow after death?* Hairs will not only endure during a long life, but will also grow after death. Cases in proof of this fact have been reported by Good, Pariset, Bichat, Villermé, Caldwell, and others. That it is not incompatible with the known laws of physiology is shown by the continuance of the life of individual cells after the organs of the body cease to do their work (somatic life). Dr. Caldwell, of Iowa, reports a remarkable case of post-mortem growth of hair. This observer was present in 1862 at the exhumation of a body which had been buried for four years. The coffin had given at the joints, and he discovered that the hair protruded through the openings. He had proof to show that the dead person was shaved before interment; nevertheless, the hair of the head measured eighteen inches, the whiskers eight inches, and the hair of the breast over four inches.[1]

The following table exhibits the classification of hair:

	FLEECY.	IN TUFTS.	STIFF.	CURLY.
Woolly hair . . .	African blacks.	Hottentots.	. . . .	. . . .
	Kaffirs.	Papuans.	. . . .	. . . .
Straight hair . . .	. . . .	. . . . .	Australians.	Dravidians.
			Hypoboreans.	Nubians.
			Americans.	Mediterraneans.
			Malays.	. . . .
			Mongolians.	. . . .

"The comparison of hair with hair, or of fibre with fibre, as to form, color, length, breadth, etc., yields at all times more valuable evidence, and furnishes data for more exact conclusions, than mere detailed information respecting the microscopical characteristics of an individual hair or fibre. Hence the actual comparison of the hair in question with hair actually removed from the person to whom it is suspected to belong should, in all medico-legal cases, be aimed at." (Tidy.) Hairs should always be washed in warm water, thoroughly dried, then steeped in turpentine, and finally mounted in Canada balsam. In all cases of examining hairs, with the exception of those suspected of containing spermatozoa, this process is to be followed.

[1] It may not be out of place here to state that post-mortem growth of the nails has been proved by careful observations.

CHAPTER XXIV.

EXAMINATION OF BLOOD-STAINS.

eneral Remarks—Human Blood—Blood-Corpuscles—Coagulation—Hæmoglobin—Hæmatin—Drying of Blood—Form and Direction of Blood-Spatters—Effects of Reagents—Preliminary Examination of Suspected Stains—Stains that are Liable to be mistaken for Blood—Methods of identifying Blood-Stains: (1) Chemical Tests (Hæmin and Guaiacum Tests); (2) Microscopic Test (Red Corpuscles; Table of Red Corpuscles; Use of High Microscopic Powers; Effects of Age on the Size of Corpuscles; Influence of Disease; Quantity of Blood in the Body; Methods of Procedure in the Examination; Measurement of Red Corpuscles; Tables).

VARIOUS medico-legal questions concerning the nature of stains resembling those of blood found on clothing, bedding, pieces of furniture, weapons, etc., are often presented to the legal physician for solution, as their identification often constitutes an important link in the chain of evidence in a trial for murder. Persons suspected of homicide frequently assert that the suspicious stains discovered on their clothing or implements are occasioned by the presence of the blood of some lower animal. Therefore, the examination and determination whether such stains are the result of human blood or not are of the greatest importance.

The main medico-legal questions connected with the identification of such stains are: (1) Are the stains blood? (2) If the stains are blood, are they old or recent? (3) What was their origin? (4) Are they human blood-stains or those from some lower animal? (5) If from an animal, is it possible to state from which animal? (6) Are the stains of venous, arterial, or menstrual blood? (7) Was the blood derived from a living or a dead subject? (8) Was the blood from a male or a female, an adult or a child?

Human Blood.—Human blood, as it exists in the human body, is a red, viscid, and homogeneous alkaline fluid of saltish taste and faint odor, with a specific gravity of 1055, the extreme limits being from 1045 to 1075. It consists of an innumerable quantity of minute solid bodies, the blood-corpuscles, and also some still more minute particles, the so-called plaques of Bizzozero, the function of which is unknown. These bodies float in a liquid known as the plasma or liquor sanguinis.

The function of the blood is to distribute the nutritious materials to the different parts of the body and to collect those substances which have resulted from the changes constantly occurring in the tissues and carry them to those organs whose function is to expel them from the system. The blood keeps up a constant intercourse between the tissues of the body and the air, thus furnishing them with oxygen.

A thousand parts of blood contain about 795 parts of water and 205 parts of solids. The latter consist of albumen, fibrin, and coloring matter containing iron, fatty bodies, cholesterin, salts, and extractive matters. The salts are made up of chlorine, lactic, sulphuric, phosphoric, oleic, uric, stearic, and hippuric acids, combined with sodium, potassium, calcium, and magnesium. The extractive matters contain minute quantities of leucin, sugar, tyrosin, creatin, xanthin, etc. According to the following table, 1000 parts of the liquor sanguinis and of the blood-corpuscles contain :

Liquor Sanguinis.		Blood-Corpuscles.	
Water	902.90 parts.	Water	688.00 parts.
Solid ingredients	97.10 parts.	Solid ingredients	312.00 parts.
	1000.00 parts.		1000.00 parts.

The following list comprises the solid ingredients of each of the above portions :

Albumen	78.84 parts.	Hæmoglobin	298.97 parts.
Fibrin	4.05 parts.	Fat	2.31 parts.
Extractive matters	3.94 parts.	Extractive matters	2.60 parts.
Mineral salts	8.55 parts.	Mineral salts	8.12 parts.
Fat	1.72 parts.		312.00 parts.
	97.10 parts.		

Blood-Corpuscles.—These are of two kinds, the red and the white. In their moist condition they constitute from forty-seven and two-tenths to fifty-four and two-tenths per cent. of the total weight of blood, and have a specific gravity of 1105. The *red blood-corpuscles* form about one-half of the bulk of the blood (513.04 parts per 1000) and give to the blood its red color. When spread out in a thin layer on a glass slide under the microscope they appear yellowish, the red hue being due to the refraction of light when in large numbers. The number of red globules in the blood is enormous ; one drop contains between four and five million, and they present an aggregate surface of about three thousand square yards, while the surface they represent for the absorption of oxygen in the lungs in one second is estimated at about eighty square yards. One grain of human blood contains about three hundred and twenty-five million red corpuscles ; and, according to Wormley, a single corpuscle weighs approximately $\frac{1}{8000000000}$ grain. (*Vide* the microscopic examination of these bodies.)

The *white blood-corpuscles* are small protoplasmic cells, somewhat similar to the round cells found in most parts of the body, and occur in large quantities in the lymph. They are also termed lymphoid cells or leucocytes. They possess a finely granular structure and nuclei, and are lighter and larger than the red globules. These corpuscles contain no cell-wall. They possess an amœboid movement under certain circumstances, being thus

› migrate and pass through the walls of blood-vessels, etc. Their haracter and appearance are the same in all kinds of blood. In they measure about $\frac{1}{2500}$ inch.

ılation.—When blood is drawn from the blood-vessels, its fibrinous s consolidate into a soft clot resembling a gelatinous mass, the which entangle the blood-corpuscles as if in a spider's web. Coag- due to the union of fibrinogen and paraglobulin (fibrinoplastin) and t necessarily present known as the fibrin ferment. Some hours clot is formed it becomes smaller and of firmer consistence on ac- the displacement of the greater part of the serum. This contrac- expulsion of serum lasts for from twenty-four to thirty-six hours. e surface of the coagulated mass is concave it is said to be *cupped;* it is covered with a grayish-yellow layer of almost pure fibrin, as nally is, the *buffy coat* is produced. The buffy coat results in es where the blood-corpuscles subside a little before becoming fixed ısolidating mass.

me required for the beginning of coagulation in man is from three inutes; it is complete in seven or eight minutes. In animals it newhat under different circumstances. According to Nasse, the he horse and the ox begins to clot in from five to thirteen minutes; ; in from one to three minutes; in the sheep, pig, and rabbit in from to one and one-half minutes; and in fowls in one and one-half The clotting of blood is slow and the clot small in cold-blooded while in birds the reverse is the rule. The tabular statement given ves the various conditions which hasten, delay, or even prevent on:

STANCES FAVORING COAGU-LATION.	CIRCUMSTANCES RETARDING COAGU-LATION.
with foreign matter.	1. Contact with the lining membrane of blood-vessels.
re to the air.	2. Cold at freezing point.
on in shallow dishes.	3. Contact with oily or greasy substances.
n with twigs, etc.	4. The addition of small amounts of alkalies.
te temperature, 37.7° C. to C. (100° F. to 120° F.).	5. The addition of concentrated solutions of neutral salts of alkalies, principally magnesium sulphate.
1 with less than twice its bulk ter.	6. The addition of egg albumen, sirup, glycerin, and much water.
f blood in the vessels or injury e lining membrane.	

ılation is *prevented* by heating the blood immediately to 56° C. '.).

ubjoined tables show (1) the composition of the living blood, (2) es after coagulation, and (3) the changes produced in the blood by with a stick or twig as it flows from the blood-vessels.

- I. BLOOD IN LIVING BODY . . . .
  - Liquor sanguinis . . .
    - Water.
    - Salts.
    - Albumen.
    - Elements of fibrin.
  - Blood-corpuscles.
- II. LIQUID BLOOD . . — Coagulated blood
  - Liquor sanguinis . .
    - Serum . . .
    - Fibrin — Clot
  - Blood-corpuscles . . . . . . — Clot
- III. LIQUID BLOOD . .
  - Liquor sanguinis . .
    - Elements of fibrin — Fibrin.
    - Albumen . . . . — Defibrinated blood.
    - Salts . . . . . . — Defibrinated blood.
    - Water . . . . . . — Defibrinated blood.
  - Blood-corpuscles . . . . — Defibrinated blood.

Hæmoglobin.—This is the coloring-matter of the red blood-corpuscles, which acts as the carrier of oxygen to the various tissues of the body. It is found in the corpuscles of all the vertebrates, with the exception of the amphioxus and leptocephalus, and also in some of the crustaceans, mollusks, insects, and worms. In the invertebrates it exists in solution in the serum of the blood. It forms different crystallizable compounds with oxygen, carbonic oxide, and nitric oxide. Two compounds, oxyhæmoglobin and methæmoglobin, result from its union with oxygen. Both of these substances possess the same crystalline form, but the color of the oxyhæmoglobin solution is different from that of the methæmoglobin solution, the former being red, while the latter is brown. These compounds are sometimes found in the urine in diseases like hæmoglobinuria, etc., and also after the ingestion of large doses of potassium chlorate.

With carbonic oxide and nitric oxide, hæmoglobin produces carbon monoxide hæmoglobin and nitric oxide hæmoglobin respectively. The former compound has some forensic interest.

The crystals of hæmoglobin are composed of hydrogen, oxygen, carbon, nitrogen, sulphur, and iron, and are soluble in water and in very dilute alkaline solutions. Ferrocyanide of potassium, acetic acid, chlorine, or nitrate of mercury precipitates the hæmoglobin from these solutions.

When hæmoglobin is treated with dilute acids, alkalies, or heated to the boiling-point of water, or only to 70° C. (158° F.), it is decomposed into *globin* and a ferruginous pigment called hæmatin.

Hæmatin.—This, as stated above, is a result of the decomposition of hæmoglobin. It is a brown pigment, and is soluble in alkaline hydrates and in alcoholic sulphuric acid, but insoluble in water, ether, and alcohol. When an alkaline solution is treated with sulphide of ammonium, the reducing effect of the latter produces hæmochromogen, another pigment, also called reduced hæmatin. When subjected to oxidation, it is reconverted to hæmatin. When relieved of its iron by certain reagents, hæmatin is decom-

posed into another product called hæmatoporphyrin, a substance of forensic importance in certain cases. This product is also obtained by heating hæmatin to a sufficiently high temperature. Professor Wood[1] says, "These decomposition products are of value from a medico-legal point of view, since it sometimes happens that blood-stains are accidentally or intentionally subjected to the action of certain influences which decompose both the hæmoglobin and the hæmatin, so that the ordinary chemical tests will not suffice to detect the blood in the stains; it may also happen that the corpuscles also have been destroyed by the action of moisture or some other condition. Hence it is possible that the recognition of a blood-stain may depend entirely on the identification of one of these decomposition products by means of the spectroscope. The recent studies of Liman, Kratter, and Hammerl have shown some of the conditions which will prevent the detection of blood in blood-stains by the application of the ordinary tests, and render necessary the examination of the stains for these other decomposition products,—hæmochromogen and hæmatoporphyrin. The action of high temperatures is especially apt to thus decompose the blood pigment."

Hæmatoidin occurs only when blood coagulates without the circulation, or becomes decomposed, as in old extravasations into the tissues. Its formula ($C_{30}H_{34}N_4O_6$) makes it homologous with bilirubin, although they have different spectroscopic effects.

Drying of Blood.—The desiccation of a spot or pool of blood is influenced by certain conditions; thus, the degree of temperature and the moisture of the atmosphere have much to do with this process. Again, the character of the surface upon which the blood strikes is of importance. An absorbent surface, such as cloth, etc., will favor the drying process much more speedily than a non-absorbent surface (glass, painted wood, steel, etc.). Large quantities of blood dry less rapidly than small quantities. This subject is of importance, forensically, as affording evidence as to the period of time at which a homicide has been committed.

Form and Direction of Blood-Spatters.—Spots of blood, if thrown out from a living blood-vessel, very speedily coagulate, and hence may serve to indicate the direction from which the blood came, or the position of the individual with respect to them when the wound was inflicted. Thus, when a blood-stain is elongated, or of an oval shape, it is very likely that the position of the person was in an oblique direction with respect to the stain during the bleeding. The direction of blood-spatters is indicated by the smaller extremity, which is farthest from the point of origin, for, as a usual thing, the force with which the blood is propelled from the artery is sufficient to drive it to the farthest end of the stain. "This peculiar shape of the stains will, when it exists, show the direction from which the blood issued, even if it has impinged upon a perpendicular surface and has a direction from below upward. If this perpendicular surface happen to be

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

rough, like an overcoat made of rough cloth, the coagulation of the blood will usually take place so rapidly that the bulk of the fluid cannot gravitate to the lower part of the stain, and the upper and narrower part of the stain will contain the larger portion of blood. On a smooth surface, however, the coagulation is usually sufficiently rapid to prevent the gravitation of the larger portion of the blood to the lower part of the stain." (Wood.)

If blood be dropped from a height of a couple of feet, the resulting spots will be larger than those dropped only a few inches, and, moreover, they will be indented along their circumference, while those in the second instance will have a perfectly regular outline. (Babcock.)

Effects of Reagents upon the Blood.—(1) *Ammonia and the Alkalies.*—If a small quantity of ammonia be added to blood, the color will either remain unchanged, or, if changed, it will be a trifle brighter and clearer. If a strong solution be employed, the color of the blood is changed to a brownish tint. Diluted ammonia water will dissolve old stains upon cloth, especially if gentle heat be applied. Caustic potash or soda, in solution, causes stains of blood upon linen to assume a dirty-greenish hue.

(2) *Heat.*—When heat is applied to blood it coagulates. On continuing the heat a flocculent reddish-brown precipitate forms, which consists of albumen combined with hæmoglobin. It is soluble in ammonia water.

(3) *Water.*—On the addition of water to blood a bright-red solution is formed, due to the coloring-matter. The hæmoglobin, by continued exposure, grows less soluble on account of the formation of methæmoglobin, and, when finally transformed into hæmatin, the hæmoglobin is quite insoluble in water. The solubility of a blood-stain will therefore depend upon its age; thus, old stains are much less soluble in cold water than recent ones, while very old ones may be wholly insoluble.

(4) *Bleaching Agents.*—Such substances as chlorine water and solutions of sulphurous acid and sodium hypochlorite effect no change in the hæmoglobin of the blood unless they are concentrated or heated with the blood.

(5) *Acids.*—The albumen of blood is coagulated and precipitated with the coloring-matter by acids of all kinds. Strong nitric acid produces a dirty-brown color with blood. The coloring-matter of dried blood is soluble in nearly all of the acids.

(6) *Tincture of Galls.*—A red precipitate is produced by tincture of galls or by an alcoholic solution of gallic acid. The precipitate contains the albumen and coloring-matter of the blood.

(7) *Alcohol, Ether, Chloroform, and Petroleum Benzine.*—Dried blood is insoluble in any one of these agents.

(8) *Guaiacum.*—On adding fresh tincture of guaiacum to blood, either in a pure state or mixed with water, there is formed a reddish-white precipitate of the guaiacum resin. If now a few drops of peroxide of hydrogen be added to this, a beautiful sapphire-blue color is developed. This test may be applied to particles of dried blood or stains upon linen, etc., when the same

tion will be given. The rich color results from the oxidation of the n of guaiacum.

Preliminary Examination of Suspected Stains.[1]—Before employ- the methods of identifying blood-stains, memoranda of the following ails should be put in writing for future reference :

"(1) Date and time of day when the specimens were received.

"(2) From whom the specimens were received, together with all par- ilars as to condition of the packages, seals (if used), place where the cimens were received, etc.

"(3) A detailed list indicating every article submitted for examination.

"(4) The number, size, shape, and exact position of the suspected stains.

"(5) If the stains are upon clothing or other fabric, note the side on ich they occur. Examine particularly all the pockets, linings, buttons, l seams. These portions often contain minute clots which escape casual ervation.

"(6) If there appear to be drops, spatters, or smudges upon any of objects, note the direction of the spatters and the appearance of the ps.

"(7) When not in use, keep the specimens under lock and key.

"(8) As the examination proceeds, each spot tested should be marked. the case of clothing, this may be done by securely pinning a small piece white linen to the side of each spot or place from which it is taken, and rking it in ink with a designating letter or figure. Chips cut from the or or furniture, and other small specimens, should be kept in separate all vials, properly labelled. Spots upon weapons may be sufficiently indi- ed by descriptive notes.

"(9) If possible, use only a portion of each stain for the examination. the case of minute spots, the whole may be required for the necessary ts, or further examination in consequence of facts developed during the l, and possibly the defendant's counsel may desire a portion for the in- ection of his own experts. In the latter case deliver nothing except upon written order of the prosecuting officers."

Stains that are Liable to be mistaken for Blood.—The following ins have been mistaken for blood :

(1) *Grease- and Tar-Stains.*—A magnifying glass will be of service in stinguishing grease- from blood-stains. They may also be detected by acing a piece of white filter-paper over the stain and pressing a hot iron on it, when more or less of the grease or tar will disappear by absorption. oth of these substances are soluble in petroleum naphtha, ether, and oil of rpentine ; they are, however, quite insoluble in water.

(2) *Pitch-Stains.*—Such stains may be detected by their color and odor. Pitch is soluble in turpentine and alcohol, neither of which solvents have any effect on blood-stains.

[1] Babcock, Hamilton's System of Legal Medicine.

(3) *Red Paint.*—This is insoluble in cold water, but it is softened and can be removed on soaking in oil of turpentine, naphtha, or in a strong solution of alkali. After a small portion of red paint has been treated with any of the above-mentioned reagents, a deposit of the mineral pigment will be found, which may be tested for iron. So the stain from *iron-moulds* is readily identified on account of its solubility in hydrochloric acid. It may also be examined for iron.

(4) *Red Fruit-Juices.*—None of these stains coagulate when subjected to heat; their color is changed upon the addition of ammonia.

(5) *Cochineal, Kino, Logwood, Madder, etc.*—These are not coagulated (when in solution) by heat, and all of them are changed in color by ammonia. Most of them are changed to a crimson or a deep-red color. Madder becomes yellow when treated with acids, and upon the addition of iron salts is changed to brown. Chlorine water, unless very concentrated, bleaches these colors.

(6) *Brazil-Wood, Red Sanders, Anatto, etc.*—Red-colored solutions are derived from these substances. Ammonia turns the red color of Brazil-wood crimson. The color of anatto is soluble in water, to which it yields an orange-yellow color; the addition of ammonia does not change this color, but, if anything, intensifies it. Sulphuric or nitric acid turns it dark blue. Red sanders and cam-wood yield their colors to ether and alcohol; they are, however, insoluble in cold water. Acids change the color of anatto to a red or pink.

(7) *Iron-Rust and Corrosions upon Metals by Vinegar, Lemon- or Orange-Juice, etc.*—Some of the various forms of iron-rust resemble dried blood. Their character may be determined by placing a detached portion in a porcelain capsule which contains hydrochloric acid, and applying heat. If the stain be from iron-rust, the particles are dissolved with the formation of a yellow solution. When a drop of this is tested by a solution of ferrocyanide of potassium, a blue color is produced. This color may be changed to a reddish-brown precipitate by alkalies. If another drop be treated with sulphocyanide of potassium, a deep-reddish tint follows. These tests are equally applicable to iron-rust stains upon linen, etc. In a case reported by Orfila a man was arrested on suspicion of murder, and on whose person was found a knife apparently smeared with blood. Upon submitting the stains to chemical examination, they were found to be due to citric acid. The man had previously used the knife for cutting a lemon, and had forgotten to wipe it after using. The contact of lemon and other like juices with steel produces a citrate of iron, which is of a light-yellow color and soluble in water. The reaction is of an acid nature. The color is not affected by ammonia or boiling.

Methods of identifying Blood-Stains.—Three series of means may be employed for the detection of blood in a stain or spot,—the chemical test, the physical or microscopic, and the spectroscopic examination. The chemical tests of importance are (1) the hæmin test and (2) the guaiacum test.

It must be observed that the chemical tests do not distinguish human blood from that of the lower animals, nor arterial from venous blood. They do, however, serve to distinguish blood from other substances.

I. Chemical Tests.

(1) **The Hæmin Test (Teichmann's).**—This consists in the formation of microscopic prisms or plates of hæmin or hæmatin hydrochloride (Teichmann's crystals). The method of procedure, as described by Babcock, is as follows: "A drop of blood-solution is taken up by the end of a glass rod and spread upon a microscope slide, so as to give it an extended surface. The slide may be set aside in a place free from dust and allowed to evaporate spontaneously, or it may be heated very carefully in the flame of a spirit-lamp, the slide being moved to and fro, so that the liquid will not be raised to a temperature of more than twenty or thirty degrees above the natural heat of the body. The warmth may be ascertained from time to time by applying the slide to the back of the hand. The temperature must not be allowed to reach 140° F. (60° C.), the point at which albumen coagulates. Should the coagulation take place, the test is likely to fail. Some writers recommend the addition of a particle of common salt to the solution during the evaporation. This is unnecessary in the case of fresh blood, because it contains a sufficient amount of this substance as a natural constituent; but with old or dried blood it is absolutely necessary. The amount required is very small. The best plan is to prepare a solution by weighing out two grains of pure sodium chloride and dissolving in eight fluidounces of distilled water. A drop of this solution is quite sufficient for the test, and is placed upon the centre of the film of evaporated blood. The drop is spread over the film so as to cover all parts of it, and dried off with the same precautions as at first. A drop of glacial acetic acid is next added to the film, the latter covered with a thin glass and the slide heated, this time to a sufficient degree to produce a slight ebullition. There is no longer any danger of the coagulation of the albumen. If the boiling be too rapid, the cover may be violently projected from the slide by the force of the vapor. If the blood to be tested is in a dried state, so that a small particle may be detached, a minute portion is placed in the centre of the slide and warmed with a drop of acetic acid. The acid is evaporated and the residue treated with the salt solution and afterwards with a fresh portion of acid, as previously described. In the case of fresh blood a single heating with the acetic acid is sufficient, but with very old blood it is frequently necessary to add the acetic acid a second time and heat it anew. When the acid has wholly evaporated, the slide is examined in the microscope under a power of three hundred or four hundred diameters. The operation is easy, but it requires a certain degree of skill in manipulation. The attempt to obtain Teichmann's crystals will often fail in unskilful hands. The principal causes of failure are the coagulation of the albumen and an excess of salt. Coagulation retards the solvent action of the acetic acid, and during the prolonged

ebullition required under such circumstances the salt may be entirely decomposed, and the evolved hydrochloric acid necessary for the formation of the crystals is expelled before it can enter into combination. The acid employed must be in its highest state of concentration, the so-called glacial acid. Acid of lower strength fails to decompose the salt. If too much salt be employed the experiment fails, and the slide shows only a mass of crystals of sodium chloride. Distilled water must be used. Ordinary water leaves a residue of organic matter and mineral salts,—in some cases very considerable in amount,—which interfere with the development of the crystals, or may produce a crystalline deposit by itself." (Hamilton's "System of Legal Medicine.")

(2) **The Guaiacum Test.**—On adding freshly prepared tincture of guaiacum[1] to an aqueous extract from the suspected stain, precipitation of the resin takes place, with the formation of a milk-white opacity in the liquid. Upon the addition of a small quantity of peroxide of hydrogen, a rich sapphire-blue color replaces the milky appearance if blood-pigment be present in the stain. In the case of very old spots, the tincture may be applied directly to the stain, the latter having previously been moistened with a drop of water. The peroxide is added immediately after the tincture. If the material stained be of such color as to obscure the reaction, such as where the spot is upon a dark surface, a small piece of tissue- or filtering-paper should be pressed upon it, when the characteristic color will be absorbed by the paper. In this manner several impressions may be taken from a single stain.

Substances like saliva, bile, and red wine will produce a blue color in the presence of the tincture of guaiacum and peroxide of hydrogen; neither of the two former substances has a red color, while the red wine requires some time to produce the same result, which, in the case of blood, is of immediate occurrence. The substances which produce a blue color with the tincture of guaiacum alone are milk, gluten, unboiled flour-paste; the fresh juice of potato, onion, carrot, dandelion, horseradish, chiccory, sorrel, cherries, currants, mushrooms, etc.; also all oxidizing agents,—hypochlorites, chlorine solution, mercuric chloride, gold chloride, nitrous ether, iron peroxide, manganese dioxide, platinum black, permanganates, and ferric chloride. The guaiacum reaction is also produced by pus, sweat-stains, nasal mucus, etc.

II. Microscopic Test.

The microscopic or physical examination not only proves the existence of blood, but also enables the examiner to differentiate between the blood of man and that of some of the lower animals. Human blood-corpuscles are readily distinguished from those of birds and reptiles by their shape, but

[1] Dissolve two or three pea-sized pieces of the resin in a fluidounce of alcohol. The color of the solution should not be deeper than pale sherry wine.

y resemble those of many of the warm-blooded animals in shape, though t in size.

The average diameter of the blood-corpuscle of the human blood is $\frac{1}{3200}$ ch. This is the average of Professor Formad. According to other authori-s it is placed at $\frac{1}{3200}$ (Wormley), $\frac{1}{3257}$ (French Medico-Legal Society), $\frac{1}{[..]57}$ (Masson), and $\frac{1}{3200}$ (Gulliver). (*Vide* Tables of Corpuscles.)

The corpuscle in human blood and in all mammalia, with the exception the camel tribe, is a round, flattened, biconcave, transparent disk, without nucleus. In camels, birds, fishes, and reptiles it is oval, larger in size, d nucleated. These differences are unmistakable, no matter whether the ood-spot be recent, old, fresh, or dry. The largest corpuscles are found the *Amphiuma*, a species of reptilia. Professor Formad[1] says that only the following animals have corpuscles larger than man,—*i.e.*, larger an $\frac{1}{3200}$ inch,—viz., the elephant, great ant-eater, walrus, sloth, platypus, hale, capybara, and (according to Wormley) opossum. Animals the cor-uscles of which are slightly below man in size—*i.e.*, having corpuscles from $\frac{1}{[..]00}$ to $\frac{1}{3200}$ inch average diameter—are the seal, beaver, musk-rat, porcu-ine, monkey, kangaroo, wolf, and guinea-pig. None of these are domestic nimals. All other animals, including all domestic animals, have blood-orpuscles of a mean diameter less than $\frac{1}{3500}$ inch, and, in fact, those ani-als which, as a rule, are blamed for blood-stains found on the clothing and pparel of criminals (ox, pig, horse, sheep, and goat)[2] have corpuscles with n average diameter less than $\frac{1}{4000}$ inch." His conclusions, based upon he above facts, are: "(1) The blood-corpuscles of birds, fishes, and rep-iles, being oval and nucleated, can never be mistaken for human blood. (2) Fresh human blood cannot be mistaken, under the microscope, for the blood of any animal the corpuscles of which have a mean diameter of less than $\frac{1}{4000}$ or even $\frac{1}{3600}$ inch. (3) *a.* If the average diameter of blood-corpuscles in fresh blood is less than $\frac{1}{4000}$, then it cannot possibly be human blood. *b.* If the diameter is more than $\frac{1}{3500}$, then it may be human blood. *c.* If the blood-corpuscles, after exhaustive measurement, give a mean diameter of

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[1] Comparative Studies of Mammalian Blood, Journal of Comparative Medicine and Surgery, July, 1888.

[2] The method of the late Dr. Richardson, of Philadelphia, for determining the difference between human blood-corpuscles and those of the various domestic animals is described as follows in the American Journal of Microscopy, June, 1881: "Place near the upper right-hand corner of a microscope slide a small drop of fresh human blood, and then with a narrow strip of glass or metal spread a thin streak of it diagonally across a glass, toward the lower left-hand corner. Next, let fall a drop of pig's blood, for example, upon the upper left-hand corner of the glass and spread a similar narrow strip so as to cross the first one at a very acute angle, forming a figure resembling an elongated capital X. On each side of the meeting-point of the two lines will be found (should the experiment succeed) areas when the two kinds of blood-corpuscles are in the same field of the microscope, and so placed as to afford excellent opportunities for direct comparison of their magnitudes."

more than $\frac{1}{3500}$, then it *is* human blood (provided it is not the blood [illegible] one of the wild beasts referred to)."

The following table shows the average size (fractions of an inch) of red corpuscles, according to different observers:

Mammals.

Man.

Gulliver	$\frac{1}{3200}$
Formad	$\frac{1}{3200}$
Wormley	$\frac{1}{3250}$
Richardson	$\frac{1}{3224}$
Ewell	$\frac{1}{3182}$
Masson	$\frac{1}{3257}$
C. Schmidt	$\frac{1}{3267}$
Flint	$\frac{1}{3500}$
Taylor	$\frac{1}{3500}$
Malinin	$\frac{1}{3300}$
Kollicker	$\frac{1}{3390}$
Robin	$\frac{1}{3484}$
Woodward (1875)	$\frac{1}{3379}$
Woodward (1876)	$\frac{1}{3093}$
Harting	$\frac{1}{3436}$
French Medico-Legal Society	$\frac{1}{3386}$
Dragendorff	$\frac{1}{3600}$

Dog.

Gulliver	$\frac{1}{3393}$
Formad	$\frac{1}{3580}$
Wormley	$\frac{1}{3561}$
Richardson	$\frac{1}{3542}$
Masson	$\frac{1}{3577}$
C. Schmidt	$\frac{1}{3636}$
H. Schmid	$\frac{1}{3346}$
Woodward	$\frac{1}{3246}$
French Medico-Legal Society	$\frac{1}{3479}$
Dragendorff	$\frac{1}{3628}$
Welcker	$\frac{1}{3485}$

Rat.

Gulliver	$\frac{1}{3754}$
Wormley	$\frac{1}{3652}$
C. Schmidt	$\frac{1}{3963}$
H. Schmid	$\frac{1}{5000}$

Ass.

Gulliver	$\frac{1}{4000}$
Wormley	$\frac{1}{3620}$

Ox.

Gulliver	$\frac{1}{4267}$
Formad	$\frac{1}{4200}$
Wormley	$\frac{1}{4219}$
Richardson	[illegible]
Masson	[illegible]
C. Schmidt	[illegible]
H. Schmid	[illegible]
French Medico-Legal Society	[illegible]
Dragendorff	[illegible]
Welcker	[illegible]

Pig.

Gulliver	[illegible]
Formad	[illegible]
Wormley	[illegible]
Richardson	[illegible]
Masson	[illegible]
C. Schmidt	[illegible]
French Medico-Legal Society	[illegible]
Dragendorff	[illegible]

Cat.

Gulliver	[illegible]
Wormley	[illegible]
Masson	[illegible]
C. Schmidt	[illegible]
French Medico-Legal Society	[illegible]
Dragendorff	[illegible]
Welcker	[illegible]

Bat.

Gulliver	[illegible]
Wormley	[illegible]

Elk.

Gulliver	[illegible]
Wormley	[illegible]

Wolf.

Gulliver	[illegible]
Formad	[illegible]
Wormley	[illegible]

Rabbit.

Gulliver	[illegible]
Formad	[illegible]
Wormley	[illegible]
Masson	[illegible]
C. Schmidt	[illegible]
French Medico-Legal Society	[illegible]
Dragendorff	[illegible]

MAMMALS—*Continued.*

Goat.

. . . . $\frac{1}{6366}$
. . . . $\frac{1}{6100}$
y . . . . $\frac{1}{6189}$
nidt . . . . $\frac{1}{6366}$
r . . . . $\frac{1}{6535}$

Horse.

r . . . . $\frac{1}{4600}$
d . . . . $\frac{1}{4310}$
ey . . . . $\frac{1}{4243}$
midt . . . . $\frac{1}{4464}$
Medico-Legal Society . . . $\frac{1}{4535}$
er . . . . $\frac{1}{4535}$

Mouse.

er . . . . $\frac{1}{3814}$
ley . . . . $\frac{1}{3743}$

Elephant.

er . . . . $\frac{1}{2745}$
ley . . . . $\frac{1}{2738}$

Mule.

ley . . . . $\frac{1}{3760}$

Camel.

er { Long diameter . . . . $\frac{1}{3123}$
er { Short diameter . . . . $\frac{1}{5876}$
ley { Long diameter . . . . $\frac{1}{3331}$
ley { Short diameter . . . . $\frac{1}{5280}$

Hippopotamus.

er . . . . $\frac{1}{3429}$
ley . . . . $\frac{1}{3560}$

Sheep.

ver . . . . $\frac{1}{5300}$
ad . . . . $\frac{1}{5000}$
nley . . . . $\frac{1}{4912}$
rdson . . . . $\frac{1}{5300}$
hmidt . . . . $\frac{1}{5649}$
chmid . . . . $\frac{1}{6060}$
ch Medico-Legal Society . . . $\frac{1}{5080}$
endorff . . . . $\frac{1}{5649}$
ker . . . . $\frac{1}{5078}$

Porcupine.

iver . . . . $\frac{1}{3369}$

Opossum.

iver . . . . $\frac{1}{3557}$
mley . . . . $\frac{1}{3145}$

Lion.

Gulliver . . . . $\frac{1}{4322}$
Wormley . . . . $\frac{1}{4142}$

Monkey.

Gulliver . . . . $\frac{1}{3412}$
Wormley . . . . $\frac{1}{3382}$
Richardson . . . . $\frac{1}{3505}$

Leopard.

Gulliver . . . . $\frac{1}{4319}$
Wormley . . . . $\frac{1}{4390}$

Ibex.

Wormley . . . . $\frac{1}{6445}$

Llama.

Gulliver { Long diameter . . . . $\frac{1}{3361}$
Gulliver { Short diameter . . . . $\frac{1}{6229}$
Wormley { Long diameter . . . . $\frac{1}{3361}$
Wormley { Short diameter . . . . $\frac{1}{6403}$

Rhinoceros.

Gulliver . . . . $\frac{1}{3765}$
Wormley . . . . $\frac{1}{3649}$

Whale.

Gulliver . . . . $\frac{1}{3099}$
Richardson . . . . $\frac{1}{3090}$

Ground Squirrel.

Wormley . . . . $\frac{1}{4000}$

Woodchuck.

Gulliver . . . . $\frac{1}{3484}$

Capybara.

Gulliver . . . . $\frac{1}{3190}$
Wormley . . . . $\frac{1}{3164}$

Raccoon.

Gulliver . . . . $\frac{1}{3950}$
Wormley . . . . $\frac{1}{4084}$

Hyena.

Gulliver . . . . $\frac{1}{3735}$
Wormley . . . . $\frac{1}{3644}$

Kangaroo.

Gulliver . . . . $\frac{1}{3440}$
Wormley . . . . $\frac{1}{3418}$

MAMMALS—*Continued.*

Guinea-Pig.

Gulliver	$\frac{1}{3538}$
Wormley	$\frac{1}{3223}$
Formad	$\frac{1}{3400}$
Masson	$\frac{1}{3500}$
Woodward	$\frac{1}{3213}$

Musk-Deer.

Gulliver	$\frac{1}{12325}$

Ocelot.

Gulliver	$\frac{1}{4200}$
Wormley	$\frac{1}{3383}$

Beaver.

Gulliver	$\frac{1}{3325}$

Duck-billed Platypus.

Gulliver	$\frac{1}{3000}$

Tapir.

Gulliver	$\frac{1}{4000}$
Wormley	$\frac{1}{4175}$

Red Squirrel.

Gulliver	$\frac{1}{4000}$
Wormley	$\frac{1}{4140}$

Buffalo.

Gulliver	$\frac{1}{4353}$
Wormley	$\frac{1}{4351}$

Musk-Rat.

Gulliver	$\frac{1}{3550}$
Wormley	$\frac{1}{3282}$

Black Bear.

Gulliver	$\frac{1}{3693}$
Wormley	$\frac{1}{3658}$

Seal.

Gulliver	$\frac{1}{3281}$

BIRDS.

Chicken.

Gulliver	Long diameter	$\frac{1}{2102}$
	Short diameter	$\frac{1}{3466}$
Wormley	Long diameter	$\frac{1}{2080}$
	Short diameter	$\frac{1}{3483}$

Duck.

Gulliver	Long diameter	$\frac{1}{1937}$
	Short diameter	$\frac{1}{3424}$
Wormley	Long diameter	$\frac{1}{1955}$
	Short diameter	$\frac{1}{3504}$

Turkey.

Gulliver	Long diameter	
	Short diameter	
Wormley	Long diameter	
	Short diameter	

Dove.

Gulliver	Long diameter	
	Short diameter	

Quail.

Gulliver	Long diameter	
	Short diameter	

Owl.

Gulliver	Long diameter	
	Short diameter	

Pigeon.

Gulliver	Long diameter	
	Short diameter	
Wormley	Long diameter	
	Short diameter	

Goose.

Gulliver	Long diameter	
	Short diameter	

Sparrow.

Gulliver	Long diameter	
	Short diameter	

FISHES.

Perch.

Gulliver	Long diameter	
	Short diameter	

Lamprey.

Gulliver	Circular	
	Diameter of nucleus	

Pike.

Gulliver	Long diameter	
	Short diameter	

Trout.

Gulliver	Long diameter	
	Short diameter	

Eel.

Gulliver	Long diameter	
	Short diameter	

Batrachians.

Frog.

ver	Long diameter	$\frac{1}{1108}$
	Short diameter	$\frac{1}{1821}$
nley	Long diameter	$\frac{1}{1080}$
	Short diameter	$\frac{1}{1801}$

Toad.

iver	Long diameter	$\frac{1}{1043}$
	Short diameter	$\frac{1}{2000}$

Proteus.

iver	Long diameter	$\frac{1}{400}$
	Short diameter	$\frac{1}{727}$

Amphiuma tridactylum.

iver	Long diameter	$\frac{1}{363}$
	Short diameter	$\frac{1}{615}$
mley	Long diameter	$\frac{1}{353}$
	Short diameter	$\frac{1}{632}$

Triton.

iver	Long diameter	$\frac{1}{340}$
	Short diameter	$\frac{1}{1380}$

Reptiles.

Land Tortoise.

Gulliver	Long diameter	$\frac{1}{1252}$
	Short diameter	$\frac{1}{2216}$
Wormley	Long diameter	$\frac{1}{1250}$
	Short diameter	$\frac{1}{2200}$

Viper.

Gulliver	Long diameter	$\frac{1}{1274}$
	Short diameter	$\frac{1}{1800}$

Lizard.

Gulliver	Long diameter	$\frac{1}{1555}$
	Short diameter	$\frac{1}{2745}$

Green Turtle.

Gulliver	Long diameter	$\frac{1}{1231}$
	Short diameter	$\frac{1}{1882}$

Boa-Constrictor.

Gulliver	Long diameter	$\frac{1}{1440}$
	Short diameter	$\frac{1}{2400}$
Wormley	Long diameter	$\frac{1}{1245}$
	Short diameter	$\frac{1}{2538}$

The average measurements above given apply to fresh blood which has n allowed to dry upon glass. In dried blood on clothing, etc., where it omes necessary to restore the corpuscles, the difficulties of exact measment are considerably greater. The differences in the measurements different observers may be attributed (1) to the micrometer, since it mpossible to make absolutely accurate measurements by means of this liance (no *true* stage micrometer was ever invented), and (2) to the at variation in size of the blood-corpuscles, not only in the same animal, t also in the same person. These differences may depend on the age, disease, or on various other causes. Babcock[1] quotes Gulliver as saying, Special circumstances, too, of which we have not yet sufficient knowledge, ly affect the value of any series of such measurements as are recorded in se tables. When the bird is much excited and the circulation quickened attempts at its capture in an aviary, the oval figure of its red corpuss may be more elongated than in the same bird when quietly at rest; . and my attention was sometimes arrested by like diversions in other tebrates at different times and seasons, though not in so many observais, and with such notes as would be needful for satisfactory conclusions. the facts are sufficient to show that exact and extensive investigations yet necessary on the comparative magnitude of the red corpuscles and

[1] Hamilton's System of Legal Medicine.

their aggregate proportion to the other parts of the blood at different seasons and under different circumstances. For example, whether minute diversities in the corpuscles may not be found in man at the tropics and at the frigid zone, in animals at rest and during violent exertion, in hibernating animals during summer and winter, in species subject to periodic changes in temperature."

The Use of High Microscopic Powers.—The late Dr. Richardson was the first to demonstrate the possibility of high microscopic powers in the diagnosis of blood-stains. By his method—that of using one-twenty-fifth and one-fiftieth of an inch immersion objectives with a micrometer eye-piece magnifying over three thousand diameters—the human red corpuscle is made to appear about one and one-eighth inches in diameter, while those of the goat and sheep appear about five-eighths of an inch in diameter and that of the ox seven-eighths of an inch. Formad obtained a still greater enlargement of the corpuscles through rephotographing normal blood-corpuscles to an amplification of ten thousand diameters, as exhibited by the following photographic measurements: human blood-corpuscles ($\frac{1}{3200}$ inch) will appear three and one-eighth inches in diameter; guinea-pig ($\frac{1}{3400}$), three inches; dog ($\frac{1}{3500}$), two and four-fifths inches; ox ($\frac{1}{4200}$), two and one-third inches; sheep ($\frac{1}{5000}$), two inches; and goat ($\frac{1}{6100}$), one and three-fifths inches.

Through microphotographs taken with a Zeiss photographic stand and the Zeiss two-millimetre apochromatic oil-immersion objective,[1] Professor E. S. Wood obtained amplifications of five thousand and two thousand five hundred diameters, respectively, of the corpuscles of man, the dog, ox, and sheep. The difference in size of these corpuscles is shown as follows: magnified five thousand diameters, the human corpuscle ($\frac{1}{3200}$ inch) measures one and nine-sixteenths inches in diameter; the dog ($\frac{1}{3500}$), one and three-sevenths inches; the ox ($\frac{1}{4200}$), one and one-fifth inches. Relatively, these measurements are one-half as large as those of Formad's mentioned above.

Effects of Age on the Size of Blood-Corpuscles.—Dr. Reese states that the blood-corpuscles in very young animals are larger than in adults of the same species,—that is, their average size is greater,—and there is a wider range between the extremes. Of three hundred corpuscles examined from the blood of puppies two days old, the mean measurement gave $\frac{1}{3090}$ inch, the largest $\frac{1}{2874}$ and the smallest $\frac{1}{4712}$. In puppies eleven weeks old the mean diameter of two hundred measurements was $\frac{1}{3351}$ inch, the largest being $\frac{1}{2828}$ and the smallest $\frac{1}{4456}$. The average size of one hundred

[1] "The amplification was first determined by photographing a standard $\frac{1}{1000}$ inch on the object micrometer, so that the lines of the $\frac{1}{1000}$-inch space were exactly two and one-half inches apart in the one case and five inches apart in the other. The apparatus being perfectly fixed and immovable, the blood-corpuscles on the slide were photographed under precisely the same conditions as the stage micrometer." (Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.)

ood-corpuscles from the blood of an infant thirty-six hours old was $\frac{1}{2820}$ ich, the largest $\frac{1}{2230}$ and the smallest $\frac{1}{4456}$. Of one hundred measurements f the corpuscles in a healthy adult, the average size was $\frac{1}{3238}$ inch, the irgest $\frac{1}{2725}$ and the smallest $\frac{1}{3774}$. ("Medical Jurisprudence and Toxi-ology.")

Ewell obtained the following results: In puppies eight days old the verage measurement of several series of one hundred corpuscles gave $\frac{1}{2985}$, [illegible], $\frac{1}{3059}$, and $\frac{1}{3125}$ inch in diameter, respectively; in a puppy eight weeks ld, examined in the same manner, the diameters were $\frac{1}{3330}$, $\frac{1}{3378}$, and $\frac{1}{3412}$, espectively; and in a puppy seventy-six days old the averages were $\frac{1}{3257}$, [illegible], and $\frac{1}{3610}$ inch, respectively. (*North American Practitioner.*)

Influence of Disease on the Corpuscles.—The number, size, shape, and color of the red blood-corpuscles may be altered by certain diseases. In pernicious anæmia this is remarkably so, the diminution in the number of the corpuscles varying from the normal standard (viz., five million per cubic millimetre) down to six hundred thousand per cubic millimetre. The diameter of the red corpuscle is diminished in such affections as diphtheria, high fever, and septicæmia, while in some of the anæmias the opposite prevails. According to Wood, the red corpuscles may be nucleated in some cases of leukæmia. Manassein observes that the red corpuscle may be diminished by septic fever and enlarged by extreme cold and the narcotism of alcoholism,[1] morphine, and hydrocyanic acid.

The following averages of Dr. Ewell are taken from Hamilton's "System of Legal Medicine," p. 176:

Man (plumbism),	average of 100 corpuscles	$\frac{1}{2950}$
Man (tuberculosis),	average of 100 corpuscles	$\frac{1}{3048}$
Man (gastritis),	average of 100 corpuscles	$\frac{1}{3067}$
Man (anæmia),	average of 100 corpuscles	$\frac{1}{3311}$

Similar alterations were found by the same observer in blood-corpuscles of the blood of persons afflicted with such diseases as purpura hæmorrhagica and syphilis.

Quantity of Blood in the Body.—The quantity of blood in man has been estimated to be equal to one-thirteenth of the body-weight. In the dog it is equal to one-eleventh or one-twelfth of the body-weight. In the rabbit it is estimated as from one-twelfth to one-thirteenth, and in the cat from one-tenth to one-twelfth.

Methods of Procedure in the Microscopic Examination of Blood-Stains.—In order to examine fresh blood-corpuscles a very small drop of blood should be placed upon a clean microscopic slide and covered with a thin glass, the edges of which should be sealed with paraffin, oil, or mounting

[1] Formad, who examined the blood in a great many cases of fatal alcoholism, found no increase in the diameter of the red corpuscle. Manassein experimented upon animals.

varnish, to prevent evaporation. Such a specimen will show the corpuscles lying flat, so that they can easily be measured. The late Professor Richardson's method is to detach a minute particle from the suspected blood-clot with the point of a cataract-needle, allowing it to fall upon a perfectly clear glass slide. The fragment is then covered with a thin covering-glass, pressed down firmly in order to crush the particle to powder. The specimen is next transferred to the microscope-stage. Pure water should be introduced at the edge of the covering-glass, and allowed to flow very slowly toward the fragment of blood. When this is reached a movement is noticed, after which an aggregation of compressed corpuscles, very faint and colorless, but very distinct, is brought to view. The corpuscles are rendered more perceptible by introducing at the edge of the covering-glass a minute portion of iodine or red aniline solution.

In preparing *dried* blood for microscopic purposes a different method of procedure is encountered. Most of the stains submitted to the medical expert for microscopic examination are in the dried state, and, further, the conditions under which they are produced are generally unknown. In order to free the corpuscles from the material or surrounding masses to which they cling, so that they may be examined under the microscope, some menstruum[1] must be employed to separate them.

The method followed by Formad in examining dried blood is first to expose it to a gentle moist heat from one to ten days, according to the age of the stain. "A small granule of the suspected blood or a fibre from the blood-stained fabric is placed on a glass slide, on a drop of a thirty- to thirty-five-per-cent. solution of caustic potash, and covered with a glass slide. If the blood-stain was recent the disintegration of the clot commences at once,

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[1] The principal menstrua are the following:

Roussin's Liquid.—Glycerin, three parts; sulphuric acid, one part; and sufficient water to give the liquid a specific gravity of 1028.

Richardson's Liquid.—Sodium chloride, three parts; water, four hundred parts.

Virchow's Liquid.—Potassium hydrate, thirty-three to thirty-five parts; water, one hundred parts.

Vibert's Liquid.—Corrosive sublimate, one part; sodium chloride, four parts; water, two hundred parts.

Welcker's Liquid.—Pure concentrated glycerin, one part; water, seven parts; the solution to be diluted to a specific gravity of 1028, the density of the blood-serum.

Malassez and Potain's Liquid.—Equal parts of a solution of gum-arabic, sulphate of sodium, and sodium chloride, each solution having a specific gravity of 1020. Professor Wood frequently uses a solution of the acetate of potassium of a specific gravity of 1030.

Müller's Liquid.—Potassium bichromate, two parts; sulphate of sodium, one part; and water, one hundred parts. Wormley employs distilled water in quantities not to exceed that originally present in the dried blood-mass examined. He also recommends a solution of glycerin (sp. gr. 1030), as it does not evaporate as readily as water alone. To the above solution a little caustic potash is added when treating an old stain.

d the isolated corpuscles separate and swim swiftly through the liquid if e stage of the microscope is slightly inclined." [1]

In case the dried blood has been treated with water or any liquid of less ensity than the serum of the blood (sp. gr. 1028), the red corpuscles gradally swell up and undergo a change of form and size. The circular disk of ammalian blood finally assumes a spherical form, with a diminution of its iameter. If the action of the water is prolonged, the corpuscle loses its aemoglobin, and consequently its color. The outline, at the same time, becomes very faint. According to Formad, corpuscles which have undergone hese changes may still be recognized under the microscope, since the ratio f diminution in the red corpuscles is uniform in all animals, and may be elied upon in the diagnosis of any blood thus affected. Therefore there is normal standard average for the normal biconcave red corpuscle of each nimal, and another for the swollen spherical corpuscle.

The following measurements, by Formad, of corpuscles artificially swollen y the absorption of water show a reduction of about one-third of their ormal diameter in all of the experiments made.

	Average Diameter of Spherical Corpuscles.	Average Diameter of Normal Corpuscles.	Normal Diameter reduced One-Third.
Man	$\frac{1}{4300}$ inch.	$\frac{1}{3200}$ inch.	$\frac{1}{4267}$ inch.
Guinea-Pig	$\frac{1}{4500}$ inch.	$\frac{1}{3400}$ inch.	$\frac{1}{4533}$ inch.
Wolf	$\frac{1}{4600}$ inch.	$\frac{1}{3450}$ inch.	$\frac{1}{4580}$ inch.
Dog	$\frac{1}{4800}$ inch.	$\frac{1}{3580}$ inch.	$\frac{1}{4773}$ inch.
Rabbit	$\frac{1}{4900}$ inch.	$\frac{1}{3662}$ inch.	$\frac{1}{4882}$ inch.
Ox	$\frac{1}{5600}$ inch.	$\frac{1}{4200}$ inch.	$\frac{1}{5600}$ inch.
Sheep	$\frac{1}{6700}$ inch.	$\frac{1}{5000}$ inch.	$\frac{1}{6667}$ inch.
Goat	$\frac{1}{8100}$ inch.	$\frac{1}{6100}$ inch.	$\frac{1}{8133}$ inch.

It is important for the examiner to note carefully all structures associated with a suspected blood-stain, for it may be possible to decide as to the origin of the blood in the spot. Thus, in the recent case of Ameer Ben Ali,[2] otherwise known as "Frenchy," who was convicted of having murdered Carrie Brown ("Old Shakespeare"), the experts for the State found that the parings of the prisoner's nails contained blood mixed with matter identical with that found in the stomach of the victim. It will also be remembered that with the blood discovered upon the clothing of Ben Ali was mixed a yellowish fluid, which proved to be the fluid of the small intestine.[3]

[1] Comparative Studies of Mammalian Blood. Philadelphia, 1888.

[2] In this case the writer testified for the defence on the subjects of the "examination of blood-stains" and on the "identity of the intestinal fluids."

[3] Further investigation of the fluid from the small intestine showed that it contained minute particles of food not completely digested. The microscope revealed the structure of these minute particles, which proved to be cabbage or some kind of salad, fibres of beef, and globules of oil and milk (cheese), etc. These substances were found to be identical with those discovered in the small intestine of the deceased

The structures that may be associated with a blood-stain or sp various kinds of hairs, muscular fibre, bone, fat, etc. Other materials associated with blood-stains are fibres of silk, cotton, wool, linen ; frag of mineral substances, such as sand, earth, bits of metal, and so on.

Certain bodies that are occasionally mistaken for blood-corpuscl starch-granules, drops of oil, epithelial scales, sporules of fungi, bacteria the disks found in spruce, pine, and other coniferous woods.

"Some of the fluids which have been recommended by certain w for soaking out of the corpuscles from blood-clots, particularly sodiun phate, sodium phosphate, and glycerin solution, if not too much dil will, in a few days, if kept in a warm place, develop spores, some of closely resemble decolorized blood-corpuscles." (Babcock.)

Measurement of Red Blood-Corpuscles.—There are several me employed in estimating the diameter of blood-corpuscles,—*e.g.*, (1) b screw micrometer, (2) by photography, and (3) by the eye-piece microm The latter method is by far the most convenient.

Professor E. R. Axtell, of Colorado, describes, in the *Journal of the A ican Medical Association*, July 27, 1895,[1] the method of using the ca lucida in the microscopic examination of blood-stains. In 1894 he wa gaged by the State as an expert in the Ford murder case, for the pu of determining the nature of certain blood-stains found upon the clothi the suspected murderer. Among the various articles submitted to hi the district attorney were the following: "One coat, labelled, 'Wor Charles Ford in the early morning of September 15, 1894 ;' shirt, pants, vest, similarly labelled ; one sombrero, without label, but understood t the hat which Ford had on when arrested ; one pair of men's shoes, lab as above." A whipstock also figured in the examination.

As the prisoner asserted that the blood-stains were from "some birds snakes," or might be rabbit's blood, a microscopic examination was m with the result "that not a single oval nor elliptical corpuscle was pres and that not a nucleated cell was to be found." This disproved Fo statement concerning the birds and snakes. With regard to the rabb blood, Professor Axtell says, "I had now to measure the corpuscles fo in the stain, and to compare this measurement with that of human blo The diameter of the human red blood-corpuscle is given by Gulli Wormley, and Treadwell as $\frac{1}{3200}$ inch, and that of the rabbit by Gullive $\frac{1}{3607}$, by Wormley at $\frac{1}{3658}$, and by Treadwell at $\frac{1}{3984}$. Assuming that and $\frac{1}{3700}$ inch is the ordinary range of the size of a rabbit's corpuscle,

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woman, and, further, the food-particles on the blood-stained clothing of the murd and those revealed by the autopsy on the deceased had reached exactly the s point in the process of digestion.

[1] "The Medico-Legal Examination of the Red Stains found on the Clothes Charles Ford, with a Plea for the Use of the Camera Lucida in the Microscopic amination of Blood-Stains."

ld have between such a corpuscle and that of the human blood a differ- e of fully $\frac{1}{450}$ inch. With a medium power such a difference could not easily detected; but with a high power we could magnify the difference, t were, and thus could easily detect it. . . . In the West we have a rabbit t is not common in the East. I refer to the long-eared jack-rabbit. I ld find no measurement of its corpuscles. The defence might insist that blood-stain was that of a jack-rabbit; so it had to be considered.

"For the sake of comparison, I proceeded next to make permanent unts of blood. I made a mount of my own blood, and in a similar manner de mounts of the blood of the cotton-tail and jack-rabbit. As my work- -time was short, I was not able to procure live rabbits, but bought rabbits ich had been killed a few hours previous, and took the blood examined m the cavities of the heart. My method of making these permanent unts was as follows: films of blood were spread on cover-glasses in the al way, and placed while yet moist in a saturated watery solution of mer- ric bichloride for half an hour. The film was next hardened by immersion methylated spirit, and subsequently in absolute alcohol. Staining with sin and hæmatoxylon was then performed in the usual manner. The clei of the leucocytes were stained by the logwood, while the red cor- scles were stained entire by the eosin.

". . . I had now gotten to the place where the measurement of the puscles of my permanent mounts and their comparison with the corpuscles nd on the clothes was all that remained, provided that I could be sure permanent mounts lost nothing by the method employed, and that my tions employed for restoring the blood-stains did all that they were sup- ed to. The method of my making my permanent mounts was first recom- nded by Dr. Muir in the *Journal of Anatomy*, and he asserted that the puscles retained their exact shape and size. I measured a number of my puscles, both in a fresh state and in my permanent mount, and they wed no variation; so I could eliminate the first doubt. As regards the ond, I found that, by taking a known blood-stain, with my solutions I ld restore the corpuscles in it to the exact size that they presented in a h state.

"The next question was how best to present the matter of measurement blood-corpuscles to an ordinary jury. I decided upon the use of the nera lucida. I was largely guided in this matter by the following extract, en from Carpenter, 'The Microscope and its Revelations,' seventh edition, ge 226: 'It is of the utmost importance to be able with accuracy, and th as much simplicity as possible, to measure the objects or parts of objects at are visible to us through the microscope. The simplest mode of doing s is to project the magnified image of the object by any of the methods scribed under "Camera Lucida and Drawing." If we carefully trace an tline of the image, and then, without disturbing any of the arrangements, nove the object from the stage and replace it with a stage micrometer, ich is simply a slip of thin glass ruled to any desired scale, such as tenths,

hundredths, thousandths of an inch, and upward. Trace now the projected image of this upon the same paper, and the means are at once before us for making a comparison between the object and a *known* scale, both being magnified to the same extent. The amount of magnification in no way affects the problem. Thus, if the drawn picture of a certain object exactly fills the interval between the drawing representing the one-hundredth of an inch, the object measures the one-hundredth of an inch; and whether we are employing a magnifying power of a hundred or a thousand diameters is not a factor that enters into our determination of the size of the object. In favor of this method of micro-measurement it will be noted: 1, that no extra apparatus is required; 2, that it is extremely simple; and 3, that it is accurate.'

"I had at my command an Abbé's camera lucida, and, with a Fasoldt micrometer graduated in $\frac{1}{5000}$ inch, I projected upon paper this scale (*vide* Fig. 1).

"The combination of power was as follows: Leitz's Ia stand, oil-immersion objective one-twelfth, No. v. eye-piece, draw-tube at one hundred and sixty millimetres.

"Having this scale carefully and accurately drawn and proved by several observers, it was an easy matter to make any number of such scales by simple measurement and the use of my drawing instruments. Each division of the scale represented $\frac{1}{5000}$ inch as projected by my combination. By dividing each division up into fifths, I was able to measure $\frac{1}{25000}$ inch, and not only do it accurately, but easily, and demonstrate it to any one.

"I now measured twenty corpuscles of the permanent mount of my own blood. The following shows these corpuscles in the scale:

"In dividing up the scale, and by a careful computation, I found the average diameter of these corpuscles to be $\frac{1}{3175}$ inch, a little less than the measurement usually given.

"Next I measured the cells found in the blood of the jack-rabbit. These cells proved to be very small and, as far as I have been able to ascertain, have not been previously measured. Diagram No. 3 shows twenty of these corpuscles. A careful computation of the average size of one hundred of these corpuscles by the camera-lucida method gave a diameter of $\frac{1}{6351}$ inch.

"My next step was the measurement of the blood-cells found in the blood of the cotton-tail. Diagram No. 4 shows the size of these cells as compared with those of human blood and blood from the jack-rabbit.

"On Diagram No. 3 I demonstrate the method of measuring up to $\frac{1}{70000}$ inch. I do this by simply dividing my $\frac{1}{5000}$ scale up into fourteen parts. The corpuscle on this scale occupies eighteen of these parts. It is then $\frac{18}{70000}$ inch in diameter or $\frac{1}{3888}$ inch. This corresponds closely to the measurement given by Treadwell. This is but the measurement of one corpuscle. My permanent mount of cotton-tail's blood was not the success that my other mounts had been, as many of the corpuscles appeared to

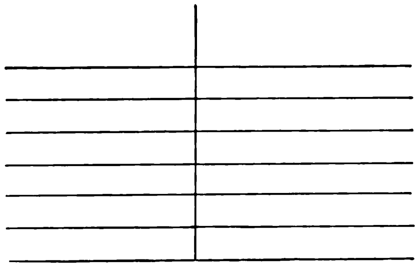

Fig. 1.

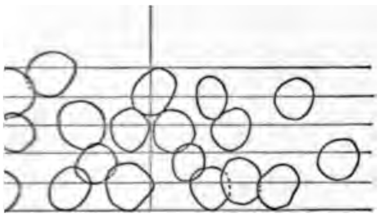

Fig. 2. Human Blood.

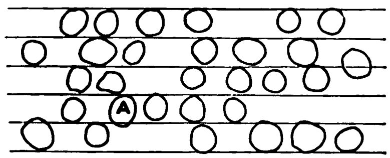

Fig. 3. Fresh Jack-Rabbit's Blood.

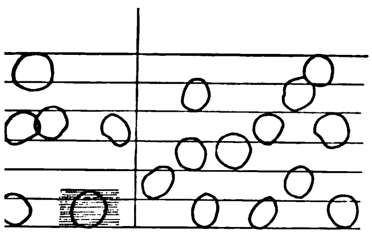

Fig. 4. Fresh Cotton-Tail's Blood.

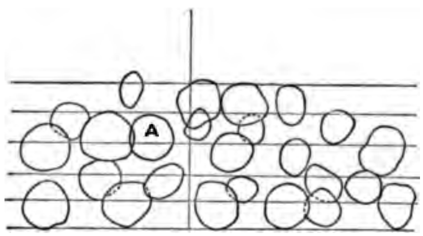

Fig. 5. Fresh Jack-Rabbit's Blood from Sleeve of Coat.

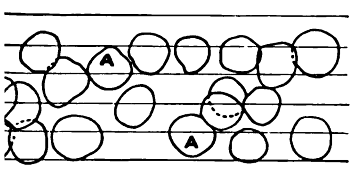

Fig. 6. From Trousers.

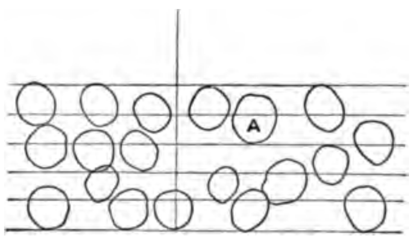

Fig. 7. From Hat.

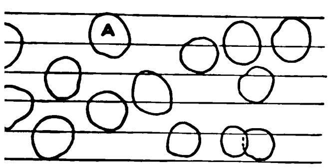

Fig. 8. Blood from Shoe.

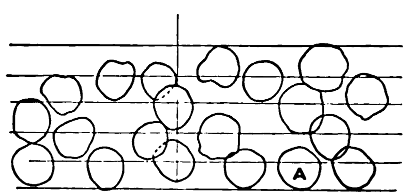

Fig 9. Blood from Whipstock.

ink by the treatment given them. Having now accurate diagrams of nan blood and of rabbit's blood, I was ready for the examination of the od-stains. These I prepared as has been detailed.[1]

"Diagram No. 5 shows the outline of the restored corpuscles as taken m the sleeve of Ford's coat. Twenty-five corpuscles are pictured, of which hteen correspond in size and measurement with human blood; seven are low this size.

"It is surprising what an array of odds and ends can be found in a raping of a blood-stain; bits of cloth-fibre, pieces of fibrin, masses of stain, anular *débris*, broken, twisted cells, and bacteria can be found, and must be fferentiated from the blood-corpuscles. Unless one becomes very familiar ith this subject, it is apt to be a perplexing study. Any round, flat mass, ough it may present irregularities, is apt to be a blood-disk. If it presents me straw or brown color and a marked appearance on slight focussing, it very probably a blood-disk. If when the cover-glass is touched with a asing-needle it rolls over and you get another view of it, you can often be bsolutely sure that the mass is a biconcave disk,—a red blood-corpuscle. requently you will find a cell that is just as clear as a fresh one can be. uch cells should be carefully drawn and designated. Cells A in the accompanying diagrams are such cells.

"Diagram No. 6 shows the blood-cells from the stains on the leg of Ford's trousers. For some reason these cells were the most perfect ones I found. Any tyro could tell that they were biconcave disks, and any one could have drawn their outline as easily as I did. There is hardly a cell shown that has not the outline of a human red blood-disk.

"Diagrams Nos. 7, 8, and 9 show the corpuscles found in the stains of the hat, shoe, and whipstock with which he was supposed to have killed the woman. As can be seen, most of them are of the diameter of the human red blood-corpuscles, and but few approach in size those of the rabbit.

"Having my exhibit thus arranged, I reported to the district attorney that the stains found on the clothes were blood-stains; that the corpuscles found in those stains were not from the blood of a fish, reptile, or bird; that they belonged to the blood of one of the class of mammalia and corresponded very closely with those of human blood, and that they did not belong to the blood of the rabbit, neither the cotton-tail nor the jack.

". . . The method of micro-measurement by the camera lucida has certainly much to commend it in such cases as the one presented. It brings to the jury's eye your own observations, and it throws on them some of the responsibility which by other methods you must share alone.

"It puts on paper for subsequent reference more than simple figures. This makes its value in work of this kind very pronounced. In the case just presented, the diagrams of comparison speak stronger than any array

[1] For a detailed description the reader is referred to the Journal of the American edical Association.

TABLE OF MEASUREMENTS BY FORMAD.[1]

Collective Results of Some of the Series of Measurements of Red Blood-Corpuscles in Blood-Stains and in Experimentally Dried Blood.

Source of Blood.	Upon what Substance.	Age of Stain.	Condition, or how prepared.	Number of Individuals examined.	Number of Preparations made.	Reagents used for Remoistening.	Time of Effect of Reagents.	Percentage of Measurable Corpuscles in each Preparation.	Total Number of Corpuscles measured.	Average Diameter in Inch.	Normal Diameter of Fresh Blood-Corpuscle.
Man. . . .	Knife and glass.	2 days.	Rapidly dried.	10	30	[2] K.O.H.	5 to 30 minutes.	20–50	1000	$\frac{1}{3260}$	$\frac{1}{3200}$
Man. . . .	Cloth.	7 days.	Slowly dried.	2	10	[2] K.O.H.	½ hour to 2 days.	5–2	250	$\frac{1}{3300}$	$\frac{1}{3200}$
Man. . . .	Wood and linen.	10 days.	Slowly dried.	4	20	[3] M.F.	2 hours to 2 days.	5–15	200	$\frac{1}{3300}$	$\frac{1}{3200}$
Man. . . .	Paper.	14 days.	[4] Dec. from moisture.	1	10	[3] M.F.	3 days.	Not measurable.			
Man. . . .	Knife.	2 years.	Well dry preserved.	1	10	K.O.H. and M.F.	2 days.	10–50	400	$\frac{1}{3240}$	$\frac{1}{3200}$
Man. . . .	Stone.	6 years.	Well preserved.	1	30	K.O.H. and M.F.	3 days.	5–20	500	$\frac{1}{3320}$	$\frac{1}{3200}$
Guinea-Pig.	Glass.	7 days.	Rapidly dried stain.	6	18	K.O.H. and M.F.	1 to 2 days.	10–40	500	$\frac{1}{3460}$	$\frac{1}{3400}$
Wolf . . .	Glass.	7 days.	Rapidly dried stain.	1	50	K.O.H. and M.F.	1 to 2 days.	5–20	1000	$\frac{1}{3450}$	$\frac{1}{3450}$
Dog	Cloth.	7 days.	Rapidly dried stains.	4	12	K.O.H. and M.F.	1 to 2 days.	5–50	500	$\frac{1}{3650}$	$\frac{1}{3580}$
Rabbit . .	Knife.	7 days.	Rapidly dried stains.	10	30	K.O.H. and M.F.	1 to 2 days.	5–50	1000	$\frac{1}{3700}$	$\frac{1}{3662}$
Ox	Cloth.	7 days.	Rapidly dried stains.	10	30	K.O.H. and M.F.	1 to 2 days.	20–40	1000	$\frac{1}{4249}$	$\frac{1}{4200}$
Sheep . . .	Glass.	7 days.	Rapidly dried stains.	3	9	K.O.H. and M.F.	1 to 2 days.	50	500	$\frac{1}{5060}$	$\frac{1}{5000}$
Goat . . .	Knife.	7 days.	Rapidly dried stains.	3	9	K.O.H. and M.F.	1 to 2 days.	50	500	$\frac{1}{6200}$	$\frac{1}{6100}$

[1] *Loc. cit.* The original table has been slightly transposed. The measurements are of normally-shaped (biconcave, disk-like) corpuscles only.

(The original table has been slightly modified.)

ANIMAL.	AGE OF STAIN.	REMARKS.	AVERAGE IN INCH.	FRESH BLOOD IN INCH.	
Human	2 months.	Stain, unknown.	$\frac{1}{3353}$	$\frac{1}{3259}$	*Vide* below.
Human	2½ months.	Stain.	$\frac{1}{3354}$	$\frac{1}{3259}$	*Vide* below.
Human	3 months.	Stain.	$\frac{1}{3354}$	$\frac{1}{3259}$	
Human	19 months.	Clot.	$\frac{1}{3390}$	$\frac{1}{3259}$	
Elephant	13 months.	Clot.	$\frac{1}{3349}$	$\frac{1}{2745}$	
Dog	4 months.	Trace of stain, unknown.	$\frac{1}{3354}$	$\frac{1}{3561}$	*Vide* below.
Rabbit	18 months.	Clot.	$\frac{1}{3653}$	$\frac{1}{3660}$	
Ox	16 months.	Stain.	$\frac{1}{4644}$	$\frac{1}{4219}$	*Vide* below.
Ox	32 months.	Stain, unknown.	$\frac{1}{4495}$	$\frac{1}{4219}$	
Ox	4½ years.	Clot.	$\frac{1}{4535}$	$\frac{1}{4219}$	
Buffalo	18 months.	Clot.	$\frac{1}{4312}$	$\frac{1}{4351}$	
Goat	17 months.	Stain.	$\frac{1}{6597}$	$\frac{1}{6189}$	
Ibex	18 months.	Clot.	$\frac{1}{6573}$	$\frac{1}{6445}$	

[1] The deposit in the case of the human blood two months old (*vide supra*) was in the form of a thin stain on muslin; its nature, other than that it was mammalian blood, was unknown at the time of its examination. Two series of thirty disks each were measured; they were readily found. Those of two and a half months, fifty disks, ranging from $\frac{1}{3153}$ to $\frac{1}{3653}$ inch, were measured. The single blood-stain of the dog was barely visible to the naked eye. Its nature was unknown. The disks of the ox blood (four and one-half years old) were rather readily obtained.

of figures. It can be used with accuracy by those who have had no previous experience in work of this kind, and by those who have not and cannot obtain the expensive screw micrometer eye-piece.

"The method and apparatus are simple, and the calculation of the size of the object is easy. To get the diameter of a corpuscle in any direction, one has only to reverse the paper bearing the reading scale. This scale can be either in millimetres or in inches, according to the stage micrometer in use.

"With it, one does not have to designate whether his measurement was taken from the outside of the dark border of the corpuscle. A faint light is used, a flat image is thrown in every case, and the corpuscle is drawn without shadowy borders. The method employed in this case is certainly one to be commended in these examinations."

III. Spectroscopic Test.[1]

This means of investigating blood-stains depends upon the fact that solutions of hæmoglobin and of its various decomposition products, when placed between the source of light and the prism of the spectroscope, absorb certain portions of the spectrum, producing in the latter certain dark bands (*absorption-bands*), which are characteristic of the presence of even minute quantities of blood. If blood be deoxidized, a single band of hæmoglobin will replace the two dark bands of the oxyhæmoglobin. This absorption-band is broad and visible in the green of the spectrum ; the blue end is also darkened.

Methæmoglobin, which results from the putrefaction of oxyhæmoglobin, produces a spectrum with the blue end darkened, the two bands of oxidized hæmoglobin quite faint, with a third absorption-band seen in the red.

Deoxidized hæmatin shows a dark and sharply defined band in the blue end and two well-defined lines in the green, with the disappearance of the band in the red.

Sorby[2] describes the spectroscopic examination as follows : "In applying the spectrum test to the detection of blood-stains, the method of examination must to some extent depend on the amount of material at command. If there be not too little, a small portion of the stained fabric should be soaked in a few drops of water in a watch-glass, the liquid squeezed out, allowed to stand a short time in the glass, so as to deposit any insoluble matter, and then poured out into one of the small, deep cells used in examining the spectrum. These cells should be made from barometer-tubing having the internal diameter of one-eighth or one-tenth of an inch, and should be one-half or three-quarters of an inch long, one end being fastened to a piece of plate-glass, like an ordinary cell for mounting objects in liquids. If the stain has been recently made, the spectrum of fresh blood

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[1] For a fuller description of the details of spectroscopic examination, the reader is referred to the larger works.

[2] Guy's Hospital Reports, 1869–70, p. 274.

would then be seen, the spectrum of oxidized hæmoglobin, which has two well-defined absorption-bands in green. If, however, the blood has been exposed for some time to the action of the air, these bands would be fainter, and another would be seen in the red, the spectrum of methæmoglobin. The relative distinctness of this shows the amount of change, and is some indication of the age of the stain; but in forming any such conclusions it is necessary to know the circumstances of the case, since the sulphurous acid met with in towns or in rooms where gas is burned produces more change in a day than pure air does in a week. If, however, little or no change has occurred in a town, it would be good evidence of the stain having been recently made. In order to make the detection of blood still more certain, it is well to observe the effects of reagents and examine other spectra. A piece of citric acid about one-fifteenth of an inch in diameter should, therefore, be dissolved in the liquid in the cell, when it will be seen that the absorption-bands of the fresh blood gradually disappear, and are not restored by the subsequent addition of excess of ammonia. This is a most important fact, since it shows that the acid produces permanent change, which is not the case in nearly all other red coloring-matters. To remove all doubt about the presence of blood, a very small piece of sulphate of protiodide of iron, not above one-hundredth of an inch in diameter, should be added to the cell, care being taken to insure the presence of excess of ammonia, and to avoid, as much as possible, oxidation by the exposure to air. It is well, therefore, not to stir up the liquid, but, having previously rather more than filled the cell, to cover it with a small piece of glass, and, after removing excess of liquid by blotting-paper, to fasten down the glass by putting around it a little gold-size. If enough citric acid and not too much sulphate of iron have been added, the protoxide of iron may be made to dissolve by turning the cell upside and downside over and over again, or by keeping it for a time upside down if the oxide has adhered to the bottom. By this means the hæmatin is slowly deoxidized and the well-marked absorption-band of deoxidized hæmatin gradually makes its appearance in the green, with a second fainter band nearer the blue end. If the solution be at all turbid the cell should be horizontal for a time, so that the insoluble matter may be deposited on the side. The production of such a remarkable and characteristic spectrum by the addition of sulphate of iron, as far as I am aware, only occurs in the case of blood, and therefore affords very conclusive evidence of the presence of that substance. With proper care these various results may be seen to perfection with about one-hundredth of a grain of blood, but I need scarcely say that before any one attempts to apply the test in any important case he should try the experiments with a little undoubted blood, so that he may be made familiar with the various spectra and quite certain that he understands all the requisite manipulations. In all cases the spectra of a suspected stain should be compared side by side with those of blood, in order to see that there is a perfect agreement; and, of course, in all of these experiments the

solution must be diluted to such an extent as to show the spectra in a proper manner."

In answer to the question, Do other substances produce similar spectra to those of blood? Sorby states that nothing gives a spectrum like that produced by oxyhæmoglobin, although various other bodies strike absorption-bands somewhat resembling the former, but are readily differentiated by their appearance under the action of reagents.

Are the stains of venous, arterial, or menstrual blood? According to Chapman,[1] venous blood can be distinguished from arterial by means of the spectroscope. Dr. Babcock, however, says, "No distinction can be made between venous and arterial blood based on chemical or microscopical examination."

Are the stains of menstrual blood? To the question whether or not blood is menstrual, Dr. Tidy says, "We urge the necessity for great caution in attempting to distinguish menstrual from ordinary blood. It has been stated (1) that menstrual blood contains no fibrin;[2] (2) that it is acid, owing to its admixture with vaginal mucus, and (3) it is invariably associated with the pavement epithelium derived from the vaginal walls. This last peculiarity is the only one of any practical importance, and in admitting its truth we doubt if in the present state of science we should be justified in venturing a *positive* opinion as to a stain being or not being menstrual from this circumstance alone." (Legal Medicine.)

In hemorrhage from the intestines or from piles the blood might be mistaken for menstrual, since there is a resemblance between the vaginal epithelium and that from the entire alimentary canal. There is also a similarity between the vaginal epithelium and that from the mucous membrane of the respiratory organs. (Babcock.)

Was the blood derived from a living or a dead subject? In trusting to the coagulation of the blood as evidence of its being derived from a living vessel or from a body recently dead, it is better, according to Tidy, "to admit the impossibility of answering this question positively, although, should coagulated fibrin be found on the stained portion, it may be stated that there is a clear presumption that the blood was derived either from a living person or from one recently dead." (*Vide* Coagulation of the Blood.)

In certain diseases, as scurvy and typhus, the blood does not readily coagulate; and it must also be remembered that coagulation *may* be retarded in the healthy body after death. Taylor says, "Blood which has escaped

[1] Medical Jurisprudence and Toxicology, Philadelphia.

[2] According to Wood, "coagula may form after the menstrual blood has left the vagina when the flow is abundant, and coagulated blood has been found within the vagina and the uterus during menstruation. In dried stains of menstrual blood, coagula of fibrin may be found with the corpuscles and vaginal cells. Menstrual blood frequently contains a smaller proportion of fibrin than blood coming directly from the blood-vessels, since it may be diluted by the fluids from the uterus and vagina."

om a recently dead body, although it would not be found diffused as if by irting, might, in so far as coagulation is concerned, assume the appearance having been effused from a living body."

Was the blood from a male, female, adult, or child? Piper describes case in which he was called in as an expert, where the blood of two persons nale and female) was distinguished from each other: "A man had been illed by a bullet through the head, shot from a pistol in the hands of his ife. The charge was that of wilful murder, resting upon the alleged statement that he was shot while lying asleep in bed. The woman had two razor-uts in her throat, and was also wounded by a pistol in her side. She stated hat her husband had attempted to murder her, and in this attempt had inlicted these wounds, and that in the scuffle she had snatched the pistol from is hand and had shot him through the head, as above stated. His body vas found lying at the farther side of the room from the bed, where, as she aid, he fell upon being shot. In the charge it was also alleged that her wounds were self-inflicted. The question presented to me for solution in he first place was as to which of the two parties the blood on the sheet belonged. If to the wife, then she was innocent of the crime charged; if to the husband, then she was guilty. Preliminary to the examination of the blood-spots themselves, I took the blood from the arm of the accused and constructed tables for the measurement of the corpuscles as described in my drawings. Next, search was made in the blood from the spots on the sheets, and the corpuscles found were arranged in similar tables. The last step in this part of the process was to make a similar examination of the blood on the carpet where the head of the dead man lay when he was found, and also of the blood-spots on the sheets on which the post-mortem was made. A number of corpuscles was found here also, which were arranged in the tables as above. Upon measuring the first and second tables, those from the arm and those from the sheet from the bed, the corpuscles were found to average very close to each other, while between these and those in the other tables, which of course came from the man, there was quite a measurable difference, the first measuring $\frac{1}{3340}$ inch, the other $\frac{1}{3080}$ inch.

"The conclusion arrived at from the results of the measurement was confirmed by the substances found in the blood on the sheet where the woman's head lay as she testified, and which, therefore, must have come from the wounds in her throat." (19 American Law Register, 608 N. S.)

It is a practical impossibility to found an answer to these queries with any degree of certainty, and it is better to at once confess our inability to do so. (*Vide* Effects of Age on the Size of Blood-Corpuscles.)

CONCLUSIONS.

Professor E. S. Wood says, "From my own experience in the examination of numerous specimens of dried blood in medico-legal cases and in dried blood of known origin, I am satisfied that if the blood is dried properly a sufficient number of red corpuscles of normal size and shape can be ob-

tained to give as satisfactory an average as in the case of fresh blood, and that whenever a satisfactory average can be obtained, as from the measurement of several hundred corpuscles of normal size, we are warranted in forming an opinion within certain limits as to the nature of the animal from which the blood in the dried state originated. If the red corpuscles are seen to be nucleated, we may decide at once that the blood did not originate from a mammal, but from one of the oviparous animals. If the corpuscles are biconcave disks having an average diameter of between $\frac{1}{3100}$ and $\frac{1}{3300}$ inch, we may say at once that it is not the blood of any animal whose corpuscles measure less on the average than $\frac{1}{4000}$ inch. This includes all the ordinary domestic animals except the dog, unless possibly the rabbit and the guinea-pig be classed among the domestic animals. The corpuscles of the ox, horse, pig, cat, sheep, and goat, being all less than $\frac{1}{4000}$ inch in diameter, can, under favorable conditions, be distinguished from those of man in dried stains. In addition to this, we may state that these measurements ($\frac{1}{3100}$ to $\frac{1}{3300}$ inch) are consistent with this blood being of human origin.

"If corpuscles of normal shape are found, and the measurement of these corpuscles shows them to average not less than $\frac{1}{4000}$ inch, we may state as positively that they are not human blood-corpuscles, but are consistent with the blood of those mammals whose corpuscles approximate in size those of the given stain.

"By far the majority of recent investigators within the last twenty years are fairly well agreed upon this : that it is possible, in the case of dried stains, to discriminate between human blood and that of most of the domestic animals ; but there are some who think that the range of variation in the size of the corpuscles in the same individual is too great to permit of a positive opinion." (Witthaus's "Medical Jurisprudence, Forensic Medicine, and Toxicology.")

Formad sums up the argument for the positive detection of human blood as follows : "It is plain, however, that the great majority, if not all, of the recent observers in the domain (certainly all who have worked with improved instruments and have employed lenses of high amplification and proper methods of micrometry) are in favor of judicious discrimination between human blood and that of animals.

"In France a committee appointed by the Société de Médecine Légale, composed of Messieurs Mayet, Mialhe, Cornil, and Lefort, decided that the expert measuring the corpuscles has the right to affirm whether or not they are human.

"Other French medico-legal examiners, such as Lacour and Masson, who made most extensive researches upon blood-stains, have testified as follows : 'One can certify that corpuscles found in the blood under examination are in all points identical with those of man or of the guinea-pig, if they measure more than $\frac{1}{127}$ millimetre.'

"The Russian medico-legal experts often testify directly that certain

d is human or not human. Professor Rudnew, of St. Petersburg, told imself that he has testified in the affirmative in regard to human blood ood-stains. Dr. Malinan, of Tiflis, Russia, a prominent expert on blood iminal cases, makes the following statement: 'If we find corpuscles in d-stains the diameter of which is .0077 millimetre or more, then we conclude that it is in all probability human blood,' and he testified in rt to that effect." ("Comparative Studies on Mammalian Blood," 8.)

Wormley says, "This difficulty of individualization arises from the fact, ve have already seen, that the average diameters of the corpuscles of erent mammals are, in many instances at least, practically the same, and se averages, for the most part, pass by imperceptible gradations through- the entire class. Thus, virtually of the same size as the corpuscles of a n are at least those of the guinea-pig, musk-rat, seal, beaver, opossum, l capybara, while those of certain other animals are but slightly larger l might be reduced in size to those of man. Hence, then, the micro- pe may enable us to determine with great certainty that blood is not that a certain animal, and is consistent with the blood of man; but in no tance does it, in itself, enable us to say that the blood is really human, or icate from what particular species of animal it was derived." ("Micro- emistry of Poisons," 1885.)

In the Cronin case at Chicago, Professor Talman testified as to the ults of his examinations of blood taken from the Carlson cottage and m the trunk, and of hair taken from the same place and Dr. Cronin's d. The following questions were then asked the witness:

Q. "In view of the examination which you have described, what do u, as a man of science, say as to the kind of blood which you dis- vered?"

A. "I should say that it was human blood, partly because the average all those measurements brings it above the generally established average human blood, which is about $\frac{1}{3200}$ or $\frac{1}{3250}$ inch; and, secondly, because kind of hair found adds very strongly to that supposition."

After discussing how to prepare blood for microscopic examination, ., the cross-examination was continued at great length. The following some of the questions submitted to the doctor:

Q. "I will ask if you can cite any recognized authority which enables u to state that you can determine, by the measurement of the corpuscles, ether or not that blood is human?"

A. "I do not think there is any recognized authority."

Q. "Do you mean to say you can testify as to whether it is the blood a guinea-pig or human being by dry corpuscles alone?"

A. "I think they would come very close together."

Q. "Do you think by the microscope it would be possible to determine difference between the dry blood of a guinea-pig and a human being?"

A. "Not if they were under $\frac{1}{3250}$ inch; it depends upon the size. If it

was $\frac{1}{8100}$ inch, I should be justified in saying it was indicative of the blood of a guinea-pig."

Q. "Can you tell anything about the size of the corpuscles?"

A. "Yes."

Q. "Is it not a fact that the size of the two are so near that you cannot determine?"

A. "If you take $\frac{1}{3250}$ as a basis you can."

Q. "Do you cite any scientists who tell us that you can tell the difference?"

A. "I do not think of any."

Q. "Can you tell us of any scientist who says he can tell the difference between the blood of a guinea-pig and a human being, or any scientist who informs us that you can tell the difference between the blood of a rabbit or the opossum and that of a human being?"

A. "Not, as I said before, where they agree in size and come up to $\frac{1}{3250}$."

Q. "Do you not know as a fact that they did?"

A. "Yes, I know it in the average." ("American and English Encyclopædia of Law," vol. xv.)

Stevenson says, "It is generally admitted by scientific men that we have at present no certain method of distinguishing human blood from other mammalian blood when it has once dried on an article of clothing or a weapon. This is practically the form in which the problem usually comes before the medical jurist. He may be able to state that the shape and size of the corpuscles as seen by the microscope are consistent with the blood being mammalian and probably human, but it is impossible to say with absolute certainty that it is not the blood of an animal like the ox or pig." (Taylor's "Manual of Medical Jurisprudence," eleventh edition.)

"Expert testimony in which distinctions are attempted between human and other mammalian blood, based on differences of $\frac{1}{10000}$ to $\frac{1}{15000}$ inch, are not generally regarded with favor, either by judge or jury. Such niceties of distinction are looked upon with considerable scepticism by jurymen accustomed only to measurements in feet and inches.

"*If the witness is able to say that 'stains are of mammalian blood, and that the diameters of the corpuscles are consistent with human blood,' and if he expressly states that they may be of other blood, he is giving testimony which will doubtless be accorded the weight to which it is entitled, and which cannot be effectively contradicted by the defence.* On the other hand, extreme opinions given in evidence always lead to contradictions between opposing experts, the result of which is that the jury are confused instead of assisted and generally disregard all the expert testimony upon that branch of the case."[1]

According to Dr. Tidy, "It would, in our judgment, be unwise to hazard an opinion as to the source of a given specimen of blood from the micro

[1] Babcock, in Hamilton's System of Legal Medicine.

copic measurements of the disks, especially considering that, as a rule, where evidence of this kind is needed, the measurements have to be made after treating the dried corpuscles with some liquid reagent." [1]

Dr. Reyburn speaks as follows: "1. Blood-stains can be certainly and absolutely differentiated from stains produced by other colored fluids by the presence or absence of the red corpuscles. 2. The blood-corpuscles of birds, fishes, and reptiles, being oval and nucleated, can never be mistaken for those of human blood. 3. If the average diameter of the blood-corpuscle in any specimen of blood (containing at least one hundred, or, better, five hundred corpuscles) is less than $\frac{1}{4000}$ inch, it cannot possibly be human blood. 4. If the blood-corpuscles have an average diameter of from $\frac{1}{3200}$ to $\frac{1}{3000}$ inch, then it is *human blood* (excluding the blood of the beaver, guinea-pig, kangaroo, monkey, musk-rat, porcupine, seal, or wolf). None of these are domestic animals, and stains produced by their blood can scarcely ever be met with under such circumstances as to be confounded with the stains of human blood. 5. Blood-corpuscles of the dog, $\frac{1}{3580}$; rabbit, $\frac{1}{3662}$; ox, $\frac{1}{4200}$; pig, $\frac{1}{4250}$; horse, $\frac{1}{4310}$; sheep, $\frac{1}{5000}$; goat, $\frac{1}{6100}$, can, by the use of high magnifying power and the careful counting of one hundred to five hundred corpuscles, be differentiated from human blood-corpuscles, both in recently shed blood and dry blood-stains." [2]

Professor Ewell states the opposing view to most of the above quoted conclusions, as follows: "According to the present state of our knowledge, it appears to be settled that the blood-corpuscles, even in the fresh state, of man, dog, rabbit, guinea-pig, musk-rat, monkey, elephant, lion, whale, seal, otter, kangaroo, capybara, wombat, and porpoise cannot be distinguished from each other by micrometric measurement. With respect to the corpuscles of other animals presenting a greater difference than exists between the corpuscles of the above-mentioned animals and those of man, it seems to the writer, in the light of the investigations above recorded, that it would be extremely perilous to undertake, by mere micrometric measurements alone, to distinguish the blood of man from that of another animal. It is possible that further investigation and more extended knowledge of the relation between these different corpuscles and of the sources of error in micrometric measurements may enable a careful observer to distinguish human blood-corpuscles from those of some other mammals, but at present it seems somewhat presumptuous." [3]

In a paper read before the Medico-Legal Society in 1892, Dr. Ewell gives the following conclusions:

"There are such large discrepancies between the averages obtained from the measurement of the *fresh* blood-corpuscles of animals of the same species, and between measurements of the same objects by different observers, as to throw doubt upon published results.

[1] Legal Medicine, vol. i. 1882.

[2] Medico-Legal Journal, September, 1892.

[3] Medical Jurisprudence, 1887.

"There is no advantage in using very high powers in such observations.

"Drying of blood-corpuscles in a clot multiplies the difficulty of identification. It has never been proven that dried corpuscles can be restored to their normal proportions.

"The mean size of the red corpuscles of very young animals is larger, and their size varies between wider limits, than in adults.

"Many diseases alter the size of red corpuscles; especially is this so in microcythæmia.

"Fasting diminishes both the size and number of the red blood-corpuscles. So, also, in the case of various drugs.

"In view of the foregoing, it is impossible in the present state of science to say of a given specimen of blood, fresh or dry, more than that it is the blood of a mammal."[1]

As to the value of the **hæmin test,** all authorities agree and accept its reliability.

"Clement says that 'the crystals of hæmin are a certain indication of the presence of blood.'

"Wormley asserts that 'their production is characteristic of blood, there being no other substance known from which they may be produced.'"

A committee appointed by the French Medico-Legal Society, composed of Mayet, Mialhe, Cornil, and Lefort, decided that "these crystals are so perfectly characteristic of blood that, should they be found, one may positively assert the presence of blood."

Professor Reese, in speaking of the value of the **spectroscopic test,** says, "We must admit that the spectroscope, *in the hands of a skilled operator*, affords the most certain and delicate test known for the presence of blood. It cannot, however, discriminate between human blood and that of any of the lower animals. In this respect, therefore, it is inferior to the microscope as a test."[2]

Mr. Sorby concludes his description of the spectroscopic test (*vide* p. 254) as follows: "In conclusion, I must say that in examining some thousands of spectra I have been led more and more firmly to believe that with anything like reasonable care there is no difficulty in obtaining satisfactory proof of the presence or absence of blood. I do not at present see any probability of deciding by the spectra from what kind of animal it came; but of course the mere fact of its presence or absence may be of great importance in connection with other evidence." He further states that he has been able to obtain hæmatin by the micro-spectroscope in a stain forty-four years old.

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[1] Medico-Legal Journal, September, 1892.

[2] Medical Jurisprudence, 1891.

CHAPTER XXV.

THE MEDICO-LEGAL CONSIDERATION OF WOUNDS.

Definitions of a Wound—Severity of Wounds—Classification of Wounds—Concussion —Fractures—Dislocations—Examination of Wounds and Injuries—Of Clothing or Dress, etc.—Evidence to be drawn from Blood-Stains—Position of the Weapon, Clothes, or Body—Distinction between wounds inflicted before or after Death—Cause of Death from Wounds—Homicidal, Suicidal, or Accidental Wounds—Presence of More than One Wound—Cicatrization of Wounds.

Definitions.—*Surgically*, a wound may be defined to be a solution in the continuity of the tissues produced by sudden force or developed spontaneously. *Medico-legally*, the idea of the term is much broader and more comprehensive, since it embraces any injury occasioned by mechanical or chemical means. Balch considers a wound "as an injury produced by violence whereby solution of continuity in hard or soft parts is occasioned, or where loss of substance from death of the part due to the violence follows its infliction." [1]

Fodéré defines a wound as "every lesion of the human body by a violent cause of which the results are, singly or combined, concussion, contusion, puncture, incision, tear, burn, twist, fracture, luxation, etc., whether the cause is directed against the body or the body against the cause."

Severity of Wounds.—In reference to persons charged with intent to injure or murder, the medical witness may be asked to give his opinion as to the danger of a given wound, in order to justify the question whether a prisoner may be admitted to bail or not. Hence upon the professional knowledge of the witness will depend the answer to the question whether a wound was or was not dangerous to life. The physician should, however, be extremely cautious in his reply when his opinion is sought upon this point.

Wounds may be considered as mortal and non-mortal, or as fatal, severe, and slight. A *mortal wound* is one which is destructive to life in a comparatively short period of time. The fact must not be overlooked that comparatively slight wounds may result fatally on account of some infection. The mortal character of a wound depends upon its position and locality in relation to vital parts, the character of the weapon employed, the amount of hemorrhage, the constitution of the person, etc. A wound of the heart, or of a great blood-vessel, or of one of the viscera, or a compound fracture of the skull, etc., may be pronounced as mortal in character.

A *severe wound* is one in which the danger to life is not imminent. Such a wound is capable of producing "grievous bodily harm," or, according to

[1] Hamilton's System of Legal Medicine.

Pollock, is "any wound requiring treatment." A *slight wound*, according to French practice, "is one which does not incapacitate one from work for more than twenty days," or it may be classified with severe wounds, "according as it is completely curable or not completely curable."

The *intent* of a person in inflicting a wound can only occasionally be inferred from the nature or situation of the injury. A medical opinion may be sought by the court upon this point, although the intent with which an injury was inflicted must be made out by evidence of a non-medical kind; hence it is a question for a jury to decide. Taylor mentions the case of a man who was "indicted for feloniously wounding a girl, with intent to do grievous bodily harm. He kicked her in the lower part of the abdomen; the surgeon described the injury as of the most serious character, and said that at one time he considered the life of the prosecutrix in danger. She was still suffering, and would probably feel the effects of the injury for the rest of her life. The judge, in summing up the case, told the jury that the material question for them to consider was the *intent* of the prisoner. It was not because serious injury was the result of the prisoner's act that they were therefore to infer his intention was to do that injury; and they were to judge from all the circumstances whether, at the time he kicked the prosecutrix, he intended to do her grievous bodily harm, as was imputed to him by the indictment, or whether he was merely guilty of a common assault. He was found guilty of a common assault."

Classification of Wounds.—The classes of wounds to be presented for consideration in the following pages are (1) incised, (2) punctured, (3) contused, and (4) lacerated. (*Gunshot wounds* will be discussed in a subsequent chapter.)

(1) **Incised Wounds.**—A wound is called *incised* when it is produced by a cutting instrument. Such a wound is characterized by the evenness and regularity of the incision, although in some instances the edges may be rough, dentated, or lacerated, as where a rough and irregular weapon is employed.

Incised wounds bleed freely and gape widely. The hemorrhage depends upon the size, number, and character of the blood-vessels involved, although it may be influenced by personal peculiarities on the part of the injured individual, such as hemorrhagic diathesis, etc. The fact must not be overlooked that such injuries may be very rapidly fatal, especially where the incision involves large and important vessels; even superficial wounds of this class may occasion dangerous or fatal hemorrhage. Bryant states that "the amount of gaping in a wound varies with the tissue divided. Skin, which is the most elastic tissue in the body, retracts when divided far more than other tissues, and transverse wounds of skin gape more than those which are longitudinal. Arteries, when wounded transversely or obliquely, gape much, and when completely divided across retract far into the tissues. Divided veins retract less than arteries. Muscles, when their fibres are cut across, shorten rapidly by contraction, and thus aid the gaping of a wound

fibrous tissues and nerves, when divided, retract but little. All wounds, however, which are made in parts in a state of tension, gape much, and tissues which are on the stretch when divided retract far more than they would do if they were relaxed. Thus, an incision made into the full breast of a suckling woman will probably, by gaping, appear as wide as it is long; while one made into the same organ in a flaccid state would gape but little. Some tissues, on the other hand, never gape on division; this is best seen in wounds of the palm of the hand and of the sole of the foot."

Coagula and clots of blood are found between the lips of incised wounds, and in a recent wound the cellular tissue is completely filled with blood.

According to Ogston,[1] incised wounds are divided into three parts,—the *commencement*, *centre*, and *end*. The commencement has but a single point of incision, while the end of the wound may present two or more serrations. Tentative incisions are frequently located at or near the commencement. If there are angular flaps on the edges of a wound, the direction in which their free angles point may show whether the incision was made from right to left, or the reverse, since they always *point* to the commencement of the wound.

Healing by *primary* adhesion or *first intention* is usually the rule in these wounds. However, when the conditions for repair are not favorable, the adhesion is by *second intention*, or the union of the divided surfaces by organized lymph or granulation tissue. The diagnosis as to the character of a wound can often be made in cases where the healing was by first intention and the cicatrix linear.

The relation of an incised wound with its supposed cause may often be ascertained by an inspection of the injured part. Thus, when an axe, hatchet, sword, etc.,[2] has been used, a certain amount of contusion may be noticed about the wound, and to this may be added crushing of the soft parts to a certain extent, and the impression of the cutting part of the weapon on the bone, or fracture. If the wound has been the result of glass, china, or crockery-ware, its edges will be found to be rough and lacerated or irregular and uneven, although in some cases they resemble the perfect incised wound. Scissor-wounds may assume the appearances of those produced by a sharp-cutting instrument, although, as a rule, they are more of the nature of punctured wounds.

As regards the particular form of the instrument that may have produced the injury, it is not always possible to ascertain this *desideratum*, although some light may be thrown upon it by the form and direction of the wound. Thus, Vibert[3] mentions a case of a wound in the neck which

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[1] Lectures on Medical Jurisprudence.

[2] In a homicide case, tried some thirteen years ago, the writer showed that the wounds found upon the head of the prisoner were occasioned by a closed, double-bladed pocket-knife, belonging to the deceased. This weapon fitted exactly into the wounds upon the prisoner's head. The prisoner was, however, acquitted, proving self-defence, having shot and killed his opponent. (*Alvin Jacobi case.*)

[3] Précis de Méd. Lég., 1890.

corresponded in form and direction to a pruning-knife. As the incision swept along, its depth was considerably increased toward the extremity of the wound, where it changed its direction, the form corresponding with the aforesaid instrument.

"In general a 'tail' or long angle in the skin at one end of an incised wound indicates the end of the wound last inflicted, and some light may thus be thrown upon the inflicter of the wound." (Woolsey.)

(2) **Punctured Wounds.**—These occupy a place intermediate between incised and lacerated wounds; but, according to Bryant, when produced with sharp-cutting instruments, they may be classed as deep incised wounds. Punctured wounds are caused by pointed instruments, and they are sometimes named after the instrument of infliction. Depth is their greatest measurement, although it is not necessarily great. These wounds are more dangerous than incised wounds, especially where they are deep and involve important structures, as the hemorrhage is generally internal. Other dangers are the carrying in of septic substances, the retention of discharge, etc.

When a wound is produced by a clean and sharp instrument in a healthy subject, the chances of recovery are greater than where the reverse prevails. "When tense fasciæ are punctured,—such as are found in the palm of the hand, sole of the foot, and scalp,—or when deep muscles, bound down by fasciæ, as in the thigh, are involved, and secondary inflammation ensues, the case is often very serious. Punctured wounds of cavities are worse than those of the soft parts covering bones, in the same way that all other wounds of those parts are graver, as well as from the fact that in punctured wounds there is more uncertainty as to the nature of the parts wounded, and that, with this uncertainty, there are, of course, less clear indications for treatment." (Bryant.)

The characters of wounds may often be of assistance in determining the kind of weapon used; in fact, the medical witness may be able to indicate the precise weapon or cause. This is especially the case in *stab-wounds.* Where the weapon has penetrated perpendicular to the surface of the part involved, the form of the wound may closely approximate that of the instrument, and show whether it be double-edged or not.[1] But where the penetration has been in an oblique direction, this correspondence will not be manifest; especially is this the case where the tissues have been stretched. In some regions of the body, where the skin is loose or wrinkled, a stab-wound may suggest the idea of more than one distinct wound.

[1] And yet, as remarked by Woolsey, "a weapon with a broad back and only one cutting edge may produce a wound resembling that of an instrument with two cutting edges, the second angle tearing as in the former class. Here on close examination we can sometimes distinguish the difference between the two angles and judge correctly of the shape of the weapon. In fact, wounds made by common pocket-knives are regularly slit-like and not wedge-shaped, as the wound is caused only by the cutting edge of the knife."

The dimensions of wounds produced by stabs may be the same as the blade making them. Another important medico-legal significance in these wounds is that they may be broader and shorter than the weapon, due to the elastic state of the skin, which retracts the edges of the wound. Again, upon the withdrawal of the weapon from the wound, the opening of the latter will be found considerably enlarged on account of the lateral motion exerted during the operation. If the wound is oblique in direction, then it measures longer than the weapon. Woolsey remarks that the exit of such wounds is smaller than the point of entrance.

Punctured wounds produced by *conical* or *cylindrical instruments* differ from stab-wounds in many particulars. For example, the edges and angles of these wounds are torn and irregular in comparison to stab-wounds produced by a knife, which are smooth and even; furthermore, a comparison of the depth with the size of the opening is a distinguishing point. The retraction of the edges of the wound is slight, while in stab-wounds it may be considerable.

Wounds made by *files*, *foils*, etc., or those caused by instruments with ridges or edges, may present the shape of the weapon, although in some instances they simulate those produced by conical or cylindrical instruments, being more or less elliptical, with two unequal angles. *Irregular perforating instruments* cause wounds similar to those which result from the violence of the application of a hard body (contused wounds).

(3) **Contusions and Contused Wounds.**—A *contusion* is a subcutaneous injury produced by a fall, or by squeezing or crushing the tissues. There is an effusion of blood, together with discoloration of the affected part. Occasionally vesicles and blebs form, and the injury may assume a gangrenous appearance. The effused blood may form a fluctuating swelling (hæmatoma), or it may coagulate and form a thrombus. The discoloration of contusions is characteristic, although it is of the utmost importance to recollect that an *ecchymosis* may be found wanting, even after a severe blow; in fact, the injury may have been sufficient to cause fatal results. On the other hand, a very slight contusion, occasioning little or no inconvenience, may produce extensive ecchymosis in the young, the aged, in females, or in those suffering from such affections as purpura, scurvy, hæmophilia, etc. Contusions in persons encumbered with a large quantity of subcutaneous fat are usually followed by extensive ecchymoses. Another fact not to be lost sight of in medico-legal investigations is that this condition cannot be produced by blows upon the dead body, although an ecchymosis produced during life may not be discernible until some hours after death. (*Vide* Ante-Mortem and Post-Mortem Ecchymoses.)

The shape of a contusing instrument or body is occasionally seen upon the bruised part, especially when the latter is of recent origin. If, however, the contusing body is very large, only a part of its area will be apparent. (*Vide* Injuries to the Head, etc.)

A *contused wound* differs from a contusion in that there is a break in

the surface of the skin; in other words, a solution of continuity. Occasionally this form of injury may present the appearance of an incision, as when the scalp is opened by a hammer or club. In wounds of this description the tissues are broken by some irregularity on the surface of the bruising body, or by the violence of its application. They are characterized by slight hemorrhage, moderate gaping, dull pain, ecchymosis, and shock. Contused wounds have thickened or ragged borders, which are apt to be swollen. It may be impossible to distinguish them when they have begun to granulate. As in the case of contusions, they may reproduce the shape of the contusing body; even the bone may show the impression of the instrument causing the injury. *Plaques parcheminées* is the term employed by the French when referring to the hard, dry, brownish-yellow condition of the skin after death. (*Vide* Contusions of the Head.)

(4) **Lacerated Wounds.**—These resemble contused wounds to a certain extent, but are followed by less discoloration and by less hemorrhage than is the case in incised wounds. They do not afford the same facility for indicating the weapon used as incised or punctured wounds, but the appearance of the wound often affords indication of the inflicting agency. Lacerated wounds are generally caused by machinery accidents, accidental tears, etc.; the prognosis is somewhat variable, for there may arise dangerous complications. Sometimes there are slow and extensive cicatrization, impairment of function, etc., all of which have an important bearing upon this point. These wounds are more often the occasion of civil proceedings than those of a criminal nature.

Concussion.—(*Vide* Wounds of the Head.)

Fractures.—A fracture is the sudden solution in the continuity of the tissue of a bone. It is called *simple* when the bone is broken at one point only, and is not accompanied by a wound leading down to the injury; *complete* when the break involves the entire thickness of the bone; *compound* when accompanied by a wound which penetrates from the surface to the plane of the fracture; *single* when there is but one line of fracture, making in the long bones two fragments; *multiple* when there are two or more breaks, the lines of fracture not communicating if these fractures are of the same bone; *comminuted* when the bone is broken into more than two fragments, the lines of fracture communicating; *impacted* when one piece is driven into the other and wedged in that position; *complicated* when it is accompanied with other serious injuries in the same region, as laceration of nerves or vessels, etc.; and *incomplete* when the bone is bent, but not entirely fractured. Fractures about joints are classed as intracapsular and extracapsular. Further, in young persons epiphyseal separation may take place, especially in the humerus.

The *symptoms* of fracture, briefly, are as follows: (1) deformity or displacement; (2) abnormal mobility; (3) crepitus; (4) loss of function; (5) pain and tenderness; (6) swelling and ecchymosis. Incomplete and impacted fractures do not present any abnormal mobility; and crepitus is

absent under the same circumstances, and also where the fragments overlap or are widely separated, etc.

The *predisposing causes* of fracture include those conditions under which the bone becomes subject to disease or injury, such as age, sex, rickets, locomotor ataxia, etc. The *exciting causes* are external violence and muscular action. *Spontaneous fractures* may occur where the bones are free from disease, and even where a moderate degree of muscular action is apparent. Taylor mentions a case of fracture of the humerus which was occasioned by throwing a cricket-ball. In such cases there are no marks of external violence. The *complications* which may arise are œdema and swelling, often followed by blebs; ulceration and sloughing of the soft parts; muscular spasm; gangrene; and, rarely, venous thrombosis, embolism, etc.

The *pathology* of fracture is as follows. There is at first free hemorrhage from the blood-vessels of the injured bone, medulla, and surrounding soft tissues. This is soon accompanied by inflammation with exudation, absorption of coagula, and deposit of plastic lymph about the neighborhood of the parts injured. The process is completed by what is called organization, the plastic lymph being converted first into cartilage and secondly into bone. The union of fractured bones is more rapid and perfect in the young than in the old, and in the upper than in the lower extremity. Union between the fractured ends of a bone does not usually commence until about ten days after the infliction of the injury, and three to six weeks are necessary[1] for the complete ossification of the callus, the time depending on the size of the bone and the accuracy of the coaptation. In some cases the union of the broken bones is delayed, while in others the continuity of the bone is not restored after twelve or more weeks. The causes of delayed union and non-union are constitutional, such as certain conditions depressing to health and nutrition, undue mobility of fragments, separation of fragments by muscular action, etc., and interference with the supply of blood.

Was the fracture produced by an accidental fall or a blow? This question is sometimes put to the medical witness. It is a common defence on these occasions to claim that the break was the result of an accidental fall. Therefore, in examining a fracture, the first thing to determine, if possible, is, Was or was not a weapon used? The state of the parts may sometimes be of service in establishing the relation of the injury with its supposed cause: thus, if in connection with the fracture there are contused, lacerated, or even incised wounds in the same track as the force which caused them, the discovery of the weapon would clear up the matter at once. Or, again, if the parts about a fracture are contused, the extent of the bruising would not only indicate the weapon used, but likewise the amount of force exerted. Balch[2] says, "Taking the bruise of the muscles into consideration, the extent and depth of this bruising would show that a fall could not have pro-

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[1] According to some authorities, four to eight weeks are required.

[2] Hamilton's System of Legal Medicine.

duced the wounding; for, undoubtedly, as the break was caused at the same time as the contusions, it being a fracture from direct violence and in line of the external injury, the impossibility of a man falling so as to cause just so much violence in one spot, without corresponding injuries which would be naturally and necessarily received by the same fall and at the same time, the breaking by direct violence and that from a weapon would be clearly shown. This presupposes careful examination of the place where the assault is stated to have taken place, as well as of the wounded limb itself. If the wounded man is suffering from fragile bones or from any cause which renders the resistance to force less strong than normal in the bones breaking, it is no aggravation of the assault, for the force used was probably such as would in no way break a bone in an ordinary man; and as no intent to such severe injury is shown, the responsibility of the break would lie with the assailed. If he did not have a condition which rendered his bones brittle, he would not have had them broken, for the force used was not sufficient to break a like bone normal in its condition."

Was the fracture produced before or after death? The answering of this question is by no means easy. The characters of fractures produced just before death and those produced shortly after death are very similar, with the possible exception that in the latter case the blood effused would be less. Where a bone has been broken some ten or twelve hours before death, the effusion of blood into the surrounding parts would be copious; one broken at a still longer period before death would be indicated by the marks of inflammation. Post-mortem fractures are not followed by an effusion of blood,—viz., fractures produced several hours after death.

How long did the deceased live after the fracture was produced? Changes do not take place until eighteen to twenty-four hours, when lymph is exuded from the surrounding parts. This is slowly organized into bone-tissue, and soon acquires all the characteristics of that substance. Hence the examination of the injured part is of the utmost importance in deciding this question. If a person dies during any of these changes, the medical witness may be asked to state the period at which the injury probably occurred, in order to connect the violence with the act of a particular individual. As a rule, the data upon which to base an answer are not trustworthy. All that can be said is as to whether a person injured lived for a long or short period after receiving the injury; to specify the precise time, however, is an impossibility. The union of bones is rapid in young persons, while in the old it is protracted or does not take place at all. According to Villermé, the callus is cartilaginous in structure from between the sixteenth to the twenty-fifth day; it becomes ossified in a period varying from three weeks to three months, and it takes from six to eight months to assume the characteristics of normal bone. (Taylor.)

Has a bone ever been broken? The existence of a fracture is often indicated by the slight unevenness or projection at the point of ossific cementation. The situation of a fracture has much to do with its recognition;

us, a fractured humerus, radius, clavicle, etc., being readily accessible or posed, offers no barrier to make its detection difficult or impossible. In ses where the bone lies deeply in the soft parts, it is hardly possible to certain whether or where a fracture has taken place. It is not possible to ate when the fracture occurred. These facts are of considerable importance the identification of the dead, particularly in the case of skeletons. In e latter instance a fracture of a bone may be ascertained by sawing it longidinally and noting whether any unusual thickness, irregularity, etc., of the ony shell exists. In such cases it will be easy to state if it were recent or ld at the time of death.

Dislocations.—These rarely call for medico-legal investigation. They re seldom dangerous to life, unless of a compound nature, or when between he vertebræ. A dislocation produced during life would be recognized postortem by the laceration of the tissues in the region of the joint and by the ffusion and coagulation of blood. An old dislocation may often be identied on dissection by the cicatrices in neighboring structures. "The diagosis of a dislocation," says Woolsey, "is easy until it has been reduced, nd then it may leave no trace except pain in and limitation of the motion f a joint, besides swelling and ecchymosis. These effects are transient, and fter they have disappeared it may be impossible to say whether a dislocation has existed on a living body, unless, as sometimes occurs, especially in the houlder-joint, there may be a temporary or permanent paralysis of a nerve and muscular atrophy."

Examination of Wounds and Injuries.—This includes their situation, shape, extent, length, breadth, and direction, and also the parts involved. Other matters of importance in connection with the examination of wounds are the condition of the edges of the wound, whether swollen, ecchymotic, smooth or straight, dentated, irregular, inverted, or everted. Note whether blood-clots are present or not, and whether the surrounding tissues are stained with blood. The characters of a wound made after death may be ascertained with much more freedom than is the case in the living; and, further, an autopsy may be necessary in order to ascertain certain facts bearing on the case. (*Vide* Classification of Wounds; Ante-Mortem and Post-Mortem Wounds; Homicidal, Suicidal, or Accidental Wounds, etc.)

Examination of Clothing, etc.—This part of the examination should be made with particular care and exactness, as it may indicate the mode in which the wound had been made by the character of the cuts, etc., on the injured clothing. It is well to recollect, however, that contused and lacerated wounds and fractures, etc., may be produced without in any manner affecting the clothing, as was observed by the writer in the case of a punctured wound of the arm, down to the humerus, occasioned by the throwing of a beer-glass across a bar-room. Marks of blood, dirt, grease, grass, etc., on the clothing may afford valuable evidence in such cases; so, likewise, fragments of clothing of either the dead person or the suspected individual, found in close proximity to the former, and which correspond with

the clothing worn at the time, may present valuable indications in the same direction. The following instance, related by Taylor,[1] shows the importance of examining the clothing, and comparing it with the injuries which may have terminated fatally. A woman was discovered dead in bed with two indentations in the right parietal bone and a large clot of blood here beneath the skin, together with a fracture of the bone four inches in extent. Three ounces of clotted blood were found between the dura mater and the skull. No other cause of death was discovered. The evidence brought out the facts that on the evening before her death she had been suddenly knocked down by a man accidentally running into her. She fell on the back of her head, was stunned, raised upon her feet, and, after some stimulants were administered to her, recovered sufficiently to walk a distance of a mile and a half to her home and eat her supper. There was a suspicion of murder in this case against a fellow-boarder; but when the bonnet worn by the woman was produced at the inquest, two indentations were noticed on the back of it corresponding to those on the woman's skull. These indentations, moreover, contained dust and dirt, thereby confirming the statement of witnesses who had seen her fall, and rendering probable what from the history seemed unlikely, that the real cause of the fatal fracture and effusion of blood was the fall.

Evidence from Blood-Stains.—(*Vide* Blood-Stains, Wounds before and after Death, etc.)

Position of the Weapon, Clothes, or Body.—The position of the weapon to the body and the position the clothes of the dead person or the coverings of the bed are found in may throw light upon the mode of death, whether homicidal, suicidal, or accidental. (*Vide* Homicidal, Suicidal, or Accidental Wounds.)

Distinction between Wounds inflicted before or after Death.—The differences between wounds inflicted *before* and *after* death should be carefully studied, for in cases of fatal injuries the defence may assert that the wound or injury was made after death. The following tabular statement shows the characters of wounds made in life and after death:

I. Incised Wounds.

1. **In the Living.**—(1) Edges regular, even, and everted, the latter due to their elasticity (the edges may be inverted in some instances,—*i.e.*, as in the scrotum, where a thin layer of muscular fibres is connected directly to the deep surface of the skin).

(2) Hemorrhage considerable, and usually arterial in character; spots of arterial blood which have spurted on a wall or furniture are of a peculiar, comet-like shape.

(3) There are coagula or clots of more or less abundance in the wound and around it (in scurvy and in the case of menstrual blood, etc., coagula-

[1] Medical Jurisprudence.

tion is retarded or imperfect; a large quantity of blood in a serous cavity, which, if inflammation exists, is found not to coagulate, or, if it does, it is imperfect).

(4) The surrounding tissues are more or less infiltrated with blood, and the edges of the wound are deeply stained with the coloring-matter (hæmoglobin), which cannot be removed by washing. The muscular and cellular tissues are especially involved. The hemorrhage is an active and not a passive one.

(5) After some hours or days evidences of repair or of inflammation are shown, such as partial or complete healing, pus, granulations, suppuration, etc.

2. **In the Dead.**—(1) Edges close and not everted, as the skin loses its vitality within a few hours after death (there may be some retraction of the skin if the wound was inflicted within a few minutes after death; but if the wound was made ten or twelve hours after death, eversion has ceased to occur).

(2) Hemorrhage scanty or absent unless a large vein is opened. The bleeding is usually venous when it occurs. The hemorrhage is a passive one.

(3) There are few or no coagula (when the animal heat of the body is lost, coagulation as well as hemorrhage, under normal conditions, ceases).

(4) There is little or no staining of the surrounding tissues (where there is staining, the blood is merely imbibed by the tissues, and may be washed off the edges of the wound).

(5) There is never any attempt at repair, and there are no signs of inflammation, although there may be a *drying up* of the edges and signs of putrefaction.

II. Contused Wounds.

1. **In the Living.**—(1) There is swelling, and, after a period varying from a few hours to a few days, if the swelling be deep-seated, the skin assumes a violet, greenish, or yellowish color, particularly at the edges.[1]

(2) There is effusion of blood into the cellular tissue under the skin; sometimes a few clots. The effused blood is due to the rupture of small blood-vessels.

(3) After some days, or even weeks, the swelling subsides and the colors fade.

(4) Abscesses may appear, or ulceration, sloughing, or erysipelas take place.

2. **In the Dead.**—(1) There is little or no swelling, and the above changes of color never appear.

(2) Very little effusion of blood takes place, and there are scarcely any clots or coagula.

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[1] According to Reese, the ecchymosis appears within twelve hours after the contusion; the violet color, within three days; the green, from the fifth to sixth day; the yellow, from the eighth to tenth day; and in healthy persons the spot disappears completely in from the twelfth to fourteenth day.—*Medical Jurisprudence.*

(3) There are no prismatic changes of color.

(4) There are no abscesses, nor any of the changes referred to above.

III. Lacerated Wounds.

1. **In the Living.**—(1) These wounds are not always followed by bleeding, although it rarely fails entirely. If the wound is in a vascular part, it may cause fatal symptoms, due to hemorrhage; on the other hand, an entire limb may possibly be torn off without much bleeding.

(2) Clots of blood may be found adhering to the edges of a lacerated wound; there are always more or less coagula present.

(3) There may be signs of vital reaction, such as suppuration, granulations, sloughing, etc., if the injured person survives a few days.

2. **In the Dead.**—There is scarcely any hemorrhage or staining (where large veins have been injured there may be some). There are no evidences of repair or inflammation, etc.

IV. Punctured and Penetrating Wounds.

1. **In the Living.**—There is always more or less hemorrhage, unless the weapon used is blunt. Evidences of vital and reparative reaction, as inflammation and suppuration, or gangrene, are often exhibited, as in other wounds.

2. **In the Dead.**—There is little or no hemorrhage or coagulation of the blood, and there are no signs in or around the wound of repair, etc. (A stab-wound of the left ventricle of the heart, after death, is followed by no hemorrhage.)[1]

Recapitulation.—The distinction between wounds inflicted before death and those made ten or twelve hours after death is not a difficult matter. Wounds inflicted during life or very shortly after death may be recognized (1) if the hemorrhage has been abundant and arterial; (2) if the blood has infiltrated and stained the tissues; (3) if the stain on the edges of the wound cannot be washed off; (4) if coagulation of the blood is complete; (5) if the coagula are firm and are found between the lips of the wound; (6) if the edges of the wound are gaping; and (7) if the sides of the wound are retracted and uneven. In the case of a contusion, if it was inflicted during life, the following signs will be recognized: (1) a bluish, violet, green, or yellow tumor, with more or less superficial œdema; (2) fluctuation or hardness of tumor, and, in either case, elasticity; (3) effused blood on incision found in tissue spaces, clotted, the coagulum being firm.

Post-mortem wounds are characterized (1) by slight or no hemorrhage; (2) hemorrhage is venous; (3) edges of wound stained by imbibition of blood; (4) stains easily washed off; (5) no clots of blood, or, if any, they

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[1] It must not be overlooked, in using the above tabular statement, that there are exceptions, and the various characters of wounds referred to are not by any means strictly accurate in all individual cases.

re soft; (6) divided arteries on surface of wound are not plugged; (7) skin f wound is not everted; and (8) the sides of the wound are smooth and in pposition. If the surface of a contusion is blue or violet in color; if there s little or no swelling of the skin; if the ecchymosed part is neither tense nor elastic; if the blood, on incision, is fluid, or, if coagulated, only partly so; and if there is no infiltration of blood into the tissues, but merely an mbibition, the presumption is that the injury was made after death. These conditions, however, are subject to modification, but in most cases they are absolutely accurate.

Cause of Death from Wounds.—It is important to remember that in cases of criminally inflicted injuries the cause of death must be certain and definite. Although there is only one real cause, other circumstances may be accessory to producing a fatal result. The only difficulty likely to obscure the real cause is where a person has recovered from the first effects of an injury or wound and subsequently dies, or where death seems to be as much dependent on disease as on an injury. The medical witness, if in doubt as to the real cause of death, should state his doubt at once to the court, as it may seriously affect the testimony if brought out on cross-examination.

Wounds may prove directly or indirectly fatal to life. A wound may be *directly* fatal when the person dies at once or very shortly after its infliction, with no other internal or external cause to account for death. A wound operates as an *indirect* or secondary cause when the injured person dies from some complication which is the direct consequence of the wound. In this connection may be included those cases wherein the person dies by reason of surgical operations necessary in the treatment of the injury. The *direct* causes of death in wounds are (1) hemorrhage, (2) severe mechanical injury, and (3) shock.

(1) *Hemorrhage.*—Loss of blood may act by causing fatal syncope, although in some instances the quantity of blood lost is insufficient for this result, and death occurs as a consequence of the disturbed function of the organ or part into which the blood is effused. Thus, in the brain it acts mechanically by causing fatal compression; and, again, in the trachea it may kill mechanically by asphyxia. In wounds involving the heart and lungs the same results follow,—*i.e.*, death is due to compression of these organs.

The *quantity* of blood necessary to cause fatal syncope is subject to great variation. Thus, less blood is required in the young, in the aged, in those diseased, and in women. Infants may die from hemorrhage resulting from very slight wounds. Taylor says that the bite of a single leech or the lancing of the gums has produced fatal hemorrhage in infants; also that the healthy and vigorous may die from the loss of small amounts of blood occasioned by the depression of their vital powers due to maltreatment or brutal violence. It is important to remember that some persons have a predisposition to hemorrhage,—a condition which is often hereditary. In such persons, while the loss of blood may not be subject to variation under the

normal conditions, still, a fatal result may follow an effusion of blood from the slightest wound or puncture. Thus, the extraction of a tooth may be attended with fatal hemorrhage, and so on with numerous other similar cases. A sudden loss of blood is of greater danger than the same amount lost slowly. This is well shown in the case of a wounded artery, where the hemorrhage is much more rapidly fatal than that from a vein or other source. To state the absolute quantity of blood necessary to be lost in order that a wound may cause death by hemorrhage is hardly possible. The total amount of blood in the body is estimated to be about one-thirteenth of the body-weight,—*i.e.*, about twelve pounds. Out of this amount one-fourth may be considered to be arterial and three-fourths venous. Watson states that a loss of from five to eight pounds would be sufficient to cause death in an adult; although fatal results have followed a much less amount, since the rapidity with which an effusion occurs, together with the age, sex, and bodily condition of the person, are influences of considerable moment. In a case mentioned by Taylor[1] a man who was wounded in the chest died within thirty-eight hours from hemorrhage occasioned by the involvement of an intercostal artery. Bleeding from a wound of the smaller branches of the external carotid artery has caused fatal results. So, likewise, injuries or wounds in vascular parts cause frequently death from hemorrhage, even although no blood-vessel of any considerable size be involved.

Internal Hemorrhage.—This form of hemorrhage, also called concealed hemorrhage, indicates bleeding into one of the cavities of the body. It may prove fatal. This is especially the case where the hemorrhage is occasioned by the rupture of such organs as the heart, lungs, liver, and kidney. Extravasation indicates hemorrhage into the areolar tissue, such as follows severe contusions or contused wounds. Large quantities of blood may in this manner produce fatal results. (*Vide* Gunshot Wounds.)

Taylor[2] cites the following *means of determining whether a person has died from hemorrhage*. If the wound be situated in a very vascular part, or if a large or moderately large blood-vessel was wounded, and the neighboring vessels, especially the veins, are found to be empty, then death may be referred to hemorrhage; and if the injured person was found to be free from disease, the case is still more apparent. Further, "This opinion may, however, be materially modified by the fact of the body not being seen on the spot where the fatal wound was actually inflicted; by the wound having been sponged, the blood removed by washing, and all traces of hemorrhage destroyed. Under these circumstances the case must in a great measure be made out of presumptive proof; and here a medical witness may have an important duty thrown upon him,—namely, that of examining articles of dress, furniture, or weapons for marks or stains of blood. It must not be supposed that all the blood met with round a wounded dead body was actually effused during life. As soon as the heart's action ceases, the arteri-

[1] Medical Jurisprudence. [2] Op. cit.

pour out no more; but the blood, so long as it remains liquid,—*i.e.*, from four to eight or ten hours,—and the warmth of the body is retained, continues to drain from the divided veins and smaller vessels. The quantity thus lost, however, is not very considerable unless the veins implicated be large."

(2) *Death from Severe Mechanical Injury to a Vital Organ.*—Direct injury to the heart, lungs, brain, etc., such as crushing, may be accompanied by fatal hemorrhage, although death may be more immediate than the loss of blood would account for, and hence the fatal effect may be ascribed to shock. Occasionally a severe mechanical injury is followed by a large effusion of blood, so that death is really the result of hemorrhage.

(3) *Death from Shock.*—Shock is a condition of nervous depression brought on by severe injuries. It is sometimes a direct cause of death. In some cases the marks of local injury are not sufficient to account for the rapidly fatal results, and death is attributed to sudden depression of the nervous system, or shock. Blows upon the pit of the stomach operate fatally by the impression they make upon the cardiac plexus, although there is no visible external or internal lesion to account for the result. Concussion of the brain, unattended by intracranial hemorrhage or laceration of the organ itself, may cause almost immediate death from shock. For example, a man is struck a severe blow upon the head, from which he dies immediately, or he becomes unconscious and succumbs to the effects of the injury within a few hours. The autopsy reveals nothing but a healthy condition of all the organs of the body. Here the cause of death can be attributed only to shock, since, as we have seen, no external or internal sign of a fatal injury exists. Medical evidence in such cases must be given with extreme caution, as the defence may claim that there was no visible wound of a sufficiently mortal character to account for death.

Fatal results may follow the shock occasioned by a multiplicity of wounds, although not one of them, alone, could be called mortal. "It is a well-ascertained medical fact," says Taylor, "that a multiplicity of injuries, each comparatively slight, are as capable of operating fatally as any single wound whereby some blood-vessel or organ important to life is directly affected. Age, sex, constitution, and the previous state of health or disease may accelerate or retard the fatal consequences. . . . It must likewise be remembered that in cases in which a person has sustained a number of injuries, the loss of a much smaller quantity of blood than in other instances will suffice to destroy life." [1]

Of two or more wounds, which was mortal? An individual wound may be said to be mortal when it is capable of causing death directly or indirectly, notwithstanding the best medical treatment. It is presumed that no other cause, such as a diseased body, etc., has intervened to hasten a fatal result.

No general rule can be laid down for determining the fatal character of wounds, as each case must be decided by its attending circumstances;

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[1] Medical Jurisprudence.

although it may be possible to state, from the nature of the parts involved, which wound was likely to have proved fatal. In some parts of the Continent two classes of mortal wounds are recognized,—*i.e.*, those which are absolutely and those which are conditionally mortal. In the former class are included those in which the best medical service is at hand, sent for, or rendered without preventing the fatal result. A conditionally mortal wound is one in which the injured person would, in all probability, have survived had medical treatment been available, sent for, or actually rendered. According to Taylor, the effect of the injury and the intent with which it was inflicted are observed rather than the anatomical relations, which are, at the most, purely accidental, and never considered in the assailant's favor.

Suppose a person receives two injuries at separate times and by different assailants, and dies: the question naturally arises, *Which of the two injuries proved fatal?* For example, the wound inflicted first was, say, a gunshot wound of the shoulder, from which the person was apparently recovering, when, in another *fracas*, he received a penetrating stab-wound of the abdomen. After hovering between life and death for a time, he finally succumbs to the effects of the injuries, and dies. If at the autopsy the stab-wound was found to have penetrated a large vessel or one of the viscera, while the injury to the shoulder was apparently of trivial importance, the decision as to which of the two wounds caused death would be comparatively an easy matter. If, on the other hand, the stab-wound was superficial in character and non-penetrating, while the shoulder-wound was found to have suppurated and produced septicæmia, death might readily be ascribed to the latter cause. In case the latter injury was proved to be the real cause of death, the first assailant could be convicted of murder, and likewise, if the stab-wound was found to be instrumental in causing the death of the victim, the second assailant could be held.

In some cases death may appear to be due to either or both wounds, in which case both assailants would be equally liable to a charge of manslaughter. Again, the second wound may be inflicted by the injured person himself with suicidal intent, or it may be of accidental origin. In either case the medical witness would have to ascertain the cause of death. Furthermore, the injured person may actually have died from the effects of poison or maltreatment. Taylor mentions a case where a young girl died while her father was chastising her for stealing. It was supposed by all that death was due to the effects of the violence inflicted by her father; and this was further strengthened from the fact that her arms, shoulders, and back bore evidences of the treatment to which she had been subjected, until an examination of the stomach, which was very much inflamed, revealed the presence of a white powder which proved to be arsenic. It seems that, on the theft being discovered, the girl took the poison for fear of her father's anger. She vomited during the flogging, and died in slight convulsions.[1]

[1] Medical Jurisprudence.

In such cases, in order to exonerate the assailant, the supervening disease, poison, or subsequent maltreatment must be of such a nature as to account for sudden or rapid death under the symptoms which really occurred before death. (Taylor.)

Was the death of the injured person due to natural causes? Here it may be claimed that, although the person was wounded, his death was due to latent natural causes. Cases are numerous where injured persons die from natural causes, although to laymen death may appear to be a direct result of the injury. This is frequently seen in cases of attempted suicide where the wounds are inflicted while laboring under disease, or some morbid change may occur subsequently and destroy life without relation to the injury. Taylor[1] remarks that where a wound or personal injuries have been inflicted by another, it is of great importance to make a careful examination of the body in order to refer death to the real cause, since a hasty opinion may involve an accused person in a charge of manslaughter.

Where the question arises as between *death from wounds or latent disease*, Taylor[2] says "that numerous causes of death may be lurking within the system at the time that a wound is criminally inflicted, and a close attention to the symptoms and post-mortem appearances can alone assist the practitioner in the difficult position in which he may be placed should the accused party be subsequently brought to trial. A man may be severely wounded, and yet death may take place from rupture of the heart, the bursting of an aneurism, from apoplexy, phthisis, or other morbid causes which it is here unnecessary to specify. If death can be clearly traced to any of these diseases by an experienced surgeon, the prisoner cannot be charged with manslaughter; for the medical witness may give his opinion that death must have taken place about the same time and under the same circumstances, whether the wound had been inflicted or not." According to Woolsey,[3] "the crime is still manslaughter and may even be murder if the assailant was actuated by malice, and the abnormal or unhealthy state of the body of the victim was taken advantage of."

A question likely to arise here is, *Was the death of the person hastened by the wound, or was the disease under which he was suffering so aggravated by the injury as to cause a more rapid termination?* To answer this question, the circumstances of the case must be considered. If the death of a person be maliciously hastened, the offence may be regarded as criminal on the principle that an injury or wound which hastens death causes death. According to Lord Hale, if a person be suffering from a disease which would probably end his life in a short time, and he receives a wound or injury which accelerates his death, such a killing would constitute murder, and the person who inflicted the injury would properly be held responsible. Taylor says, "If the person maltreated be an infant, or a decrepit old man, or one labor-

[1] Medical Jurisprudence. [2] Ibid.

[3] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

ing under a mortal disease, it is notorious that a comparatively slight degree of violence will destroy life in these cases."

Another question that may arise is that *death was not necessarily the result of the injury, since it might have been avoided by good medical treatment.* It is well known that there are many kinds of wounds which prove fatal only when improperly treated. The medical witness may be called upon to express his opinion as to how far the treatment in the latter case irritated the effects of the wound. Upon his answer will depend the decision of the jury as to the degree of criminality which attaches to the suspected person. Taylor[1] supposes the following case. An ignorant person interferes with a clot of blood which arrested the hemorrhage from a vessel, and the injured person dies in consequence of such interference; or he caused death by unnecessarily examining a penetrating wound of the chest or abdomen. Here the question arises, Would such mitigating circumstances be in favor of the accused? Undoubtedly so, since it would be unjust to hold the accused responsible for such meddlesome treatment. Of course the mitigation is only admitted on the supposition that the original nature of the wound was not mortal. Woolsey[2] says, "Medically speaking, we can seldom make the sharp distinction which Lord Hale did legally between a wound becoming mortal from improper treatment and one in which improper treatment causes death irrespective of the wound. In case of a slight wound this distinction might be possible, but not so in case of severe wounds; also, there would probably be no conviction, as far as the medical evidence is concerned, if the wound was mortal in consequence of improper treatment only, and not mortal as its usual and probable result."

Regarding the *comparative skill in treatment of wounds,*—a question which might arise. If the death of a person be entirely or partly due to an injury inflicted by another, the responsibility of the latter is not lessened by maltreatment. Taylor[3] quotes the following case, reported by Alison, in support of this. "The prisoner was one of a party of smugglers who fired at an officer of excise. The wounded man was carried to the nearest village, where he was attended by the surgeon of the country, who was not deficient in attention; but a great collection of matter formed in the leg, fever ensued, and the patient died at the end of three weeks. In defence it was urged that by skilful treatment the man might have recovered; but the court held that it was incumbent to prove that death arose *ex malo regimine.*" If the medical treatment was so unskilful as to cause death, it *would* be a mitigating circumstance in favor of the original author of the injury; "but if it arise from the want merely of the higher skill, which can only be commanded in great towns," says Taylor, "he will be responsible, because he has wilfully exposed the deceased to a risk from which he has practically no means of escaping."

[1] Medical Jurisprudence.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

[3] Medical Jurisprudence.

Again, it may be claimed by the defence that *death was not necessarily the result of the injury, and might have been avoided but for imprudence or neglect on the part of the injured person.* It sometimes happens that the wounded person absolutely refuses all medical attention, or, in case he does receive it, acts contrary to the advice of the physician, and in fact does all in his power to offset the plans for his recovery. In such cases, or where the neglect to summon medical assistance causes death, the assailant would still be held responsible for the result of the injury, and could be convicted of manslaughter. Thus, in a case supposed by Taylor,[1] a man may receive a lacerated wound of an extremity, inflicted by another, and subsequently die from tetanus or gangrene. Medical advice may have been declined, although proposed by his physician. This would not be allowed as a mitigatory circumstance in favor of the accused, since the injured person is not obliged to summon or submit to medical treatment, and the medical witness could not always be prepared to swear that an operation or other treatment would have prevented death.

Sometimes the question arises that *death might have been avoided but for some abnormal or unhealthy condition of the body of the injured person.* Thus, in some instances, a person suffering from a slight wound may die, owing to its indirect action as a result of the unhealthy state of the victim's body at the time of receiving the injury. Again, certain abnormal anatomical conditions, such as a brittle state of the bones, or a thin skull,[2] etc., may prevail, so that the most trivial injury may be followed by fatal results. Here the evidence furnished by the medical witness may be such as to diminish the responsibility of the assailant, and hence lessen the punishment. As Taylor[3] remarks, "The consequence may be, medically speaking, unusual or unexpected, and, but for circumstances wholly independent of the act of the accused, would not have been likely to destroy life. In general, in the absence of malice, this appears to be the point to which the law closely looks, in order to make out the responsibility of the accused,—namely, that the fatal secondary cause must be something not unusual or unexpected as a consequence of the particular injury; and the medico-legal question presents itself under this form: Would the same amount of injury have been likely to cause death in a person of ordinary health or vigor? Men who have suddenly changed their habits of living, and have passed from a full diet to abstemiousness, are unable to bear up against comparatively slight injuries, and often sink from the secondary consequences. So a man, otherwise healthy, laboring under hernia, may receive a blow in the groin, attended with rupture of the intestine, gangrene, and death; another, with a calculus in the kidney, may be struck in the loins, and die in consequence of the

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[1] Medical Jurisprudence.

[2] The writer recalls an instance where a child six years of age was killed by a blow on the head from a spoon in the hands of a servant. The result was a compound depressed fracture of the skull. The latter was very thin.

[3] Medical Jurisprudence.

calculus perforating the renal vessels and causing fatal hemorrhage, or from subsequent inflammation."

In case of *death following slight personal injuries*, the claim may be that death was not the result of the injury, but was due to other causes. In such cases there is commonly some diseased state of the body to clear up this result. When this disease which occasions doubt is located in a part other than that of the injury, a careful examination will clear up the case; but if the disease and the injury are found in the same locality, the case becomes much more difficult. With careful attention the ordinary results of such injuries will become explicable. Taylor[1] says, "The violence may have been too slight to account for the diseased appearance, and the disease itself, although situated in the part injured, may be regarded as a most unusual consequence of such an injury."

When death takes place from wounds after long periods, it may be claimed that this result was not necessarily due to the injury. From a medical point of view the cause of death is clearly traceable to the wound. Sir Astley Cooper mentions the case of a man who died from the effects of an injury to the head which he received two years previously. In this case death was clearly traceable to the results of the injury,—*i.e.*, the symptoms of cerebral disturbance,—which continued from the time of receiving the wound to the death of the victim. Many cases might be cited to show the length of time which may elapse before death occurs. In English law an accused person cannot be adjudged guilty of murder unless the victim of the assault dies within a year and a day after receiving the injury. In practice this law is of little importance, as most wounds cause death within two or three months after their infliction; but in principle it is wrong, medically speaking. It is of the utmost importance on the part of the medical witness to make a careful examination of the injured part, as by this means the cause of death may be connected with the injury.

Indirect or Secondary Causes of Death from Wounds.—These are numerous and varied. A wound or injury is indirectly or secondarily fatal when a person, having recovered from the immediate effects of such injury, dies from some wound, disease, or accident, or from surgical interference, including the use of anæsthetics. Woolsey[2] says, "There may be much difficulty in establishing the proof of death from a wound by means of secondary causes; for, first, the secondary cause must be in the natural course of things; and, secondly, there must be no other accidental circumstances to occasion the secondary cause."

The following may be regarded as the most common of the remote causes of death:[3] tetanus, erysipelas, hospital gangrene, septicæmia, pyæmia, delirium tremens, surgical operations, and anæsthetics.

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[1] Medical Jurisprudence.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

[3] The reader is referred to works on surgery for a more detailed description of the remote causes of death.

Tetanus[1] is an infectious bacterial disease which produces a tonic spasm of the voluntary muscles with clonic exacerbations. It generally follows punctured and lacerated wounds, and is always a serious complication. The prognosis is bad in acute cases, but is more favorable if the patient lives until the twelfth day. It rarely manifests itself before the seventh day after the infliction of the wound. The writer has made many autopsies on victims of this disease. He has seen two cases in life. The diagnosis of this affection is easy.

Erysipelas is an infectious, spreading inflammation due to the presence of a micro-organism,—*Streptococcus erysipelatis*. The exciting cause attacks the lymphatics of the skin, and effects an entrance through some wound or abrasion of the skin or mucous membrane. Erysipelas may give to wounds a fatal issue, hence it is always to be looked upon as a serious complication. It is particularly apt to follow injuries to the scalp, and may assume an epidemic form, especially in crowded places, as hospitals. Facial erysipelas is a common variety. The prognosis of this affection is usually good. Woolsey[2] says, "If a man wounded in an assault is taken to a hospital where erysipelas prevails, the question of responsibility arises, for, medically speaking, he is subjected to great and avoidable risks."

Hospital gangrene is another result of wounds which often proves fatal. It may assume an epidemic form. It results from the infection of the wound by specific germs through the medium of a foul atmosphere, impure instruments, etc. The inflammation produced is of a violent nature, although it does not spread as rapidly as that occasioned by erysipelas. It exercises a fatal action on the parts involved, producing mortification. The circumstances which predispose to attacks of hospital gangrene are overcrowding, deficient ventilation, want of proper nourishment; in fact, any depressing cause. It is, however, rarely seen nowadays except in military hospitals.

Septicæmia is a general febrile affection occasioned by the absorption of the products of putrefaction. It is most liable to take place in wounds not treated with antiseptic precautions, or in those which, from their various peculiarities, cannot be thoroughly disinfected and protected. Since there are two sources of origin, there are also two forms of this affection,—*i.e.*, (1) a septic intoxication or sapræmia, and (2) a septic affection which comes on more gradually. The former is due to the absorption of ptomaïnes, and begins acutely. The prognosis is grave.

Pyæmia is a septic fever, closely allied to septicæmia, which is characterized by the formation of metastatic abscesses due to *staphylococci* and *streptococci*, pathogenic organisms which enter the circulation. There is scarcely any appreciable difference existing between this and septicæmia, as

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[1] *Vide* Tetanus (American Medico-Surgical Bulletin, August 1, 1895), by Justin Herold, A.M., M.D.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

they both depend upon the same cause and are of the same nature. Spontaneous pyæmia is of rare occurrence, if it occurs at all. The prognosis, like that of septicæmia, is very grave. The failure to employ antiseptic means in the treatment of both septicæmia and this affection may be adduced by the defence in lessening the responsibility of the person charged with the fatal assault.

Delirium tremens often occurs as a secondary consequence of wounds or surgical operations in the case of those who are habitually under the influence of liquor. The alcoholic forms of traumatic delirium are characterized by an asthenic delirium, a soft, full, and quick pulse, tremulousness, and absence of fever. The prognosis in cases following surgical operations is rather grave. It may be alleged in such cases that death woutd have been avoidable but for the unhealthy state of the body.

Surgical Interference and the Use of Anæsthetics.—If the operation, which is a part of the treatment of the wound, is skilfully done, then the accused person may be held for the result. In wounds dangerous to life the necessity and mode of performing the operation must be left to the surgeon's judgment; therefore, the question of the propriety of such an interference becomes of great importance. Without this method of treatment the patient will surely die, while, on the other hand, fatal results may follow the shock occasioned by the operation. A serious question is here presented,—*i.e.*, that of the legal responsibility for the death; for it may be claimed for the defence, in the event of a trial, that the fatal issue was not due to the original wound inflicted by the prisoner, but was the result of the surgical operation. This question becomes paramount if it has been proved that the original wound was not of a serious character, or, if the operation was meddlesome and performed carelessly. (*Vide* Medical Malpractice.)

The circumstances regarded by the law in death following surgical operations are: (1) the necessity of the operation; (2) the competence of the operator; and (3) whether the wound would have been fatal without the operation. (Woolsey.)

Taylor says that the responsibility assumed by physicians who are connected with cases of criminal wounding is very serious; for any deviation from common practice will, in the event of death, be eagerly sought by the defence in mitigation of the responsibility of their client for the fatal result. On such occasions every surgical point advocated by the physician in the treatment of the case will be thoroughly sifted by the prisoner's counsel, and in case the injured person dies, the defence of the prisoner will be that the surgical interference was unwarrantable or unskilfully employed.

Death may follow the employment of *anæsthetics* in an operation, and here the question at issue would be, Was the administration of the anæsthetic called for, and did it form a proper part of the treatment, and was its administration skilfully carried out? The above-mentioned remarks regarding surgical interference will apply here. It may be added, however, that as death may be alleged to be the result of the employment of the anæs-

thetic, it is best, for self-protection, to employ that anæsthetic which is most universally used in the particular part of the country in question. The practitioner must not overlook the fact that it is criminal on his part to operate contrary to the will of a person, and, further, any misconduct from ignorance or inattention, whereby a patient dies, will be sufficient to convict him of manslaughter.

Homicidal or Suicidal Wounds.—*Was the wound self-inflicted or was it made by another?* To reply intelligently to this important medico-legal question, certain points relative to the wound, together with such evidence as may be furnished by the weapon, the signs of struggle, the examination of the clothing and body of the victim, must be carefully considered. The points with regard to the wound are its situation, its nature and extent, and its direction.

1. *The Situation of the Wound.*—Suicidal wounds are usually inflicted upon those parts which are readily accessible to the hand. The great majority of these injuries, if produced by *cutting instruments*, are located upon the throat and chest. Punctured wounds are usually in the region of the heart. If *fire-arms* (*vide* Gunshot Wounds) are used, the site selected for the infliction of the injury is the chest (in the region of the heart), the mouth, the orbit, the forehead, or the temples. As regards the infliction of wounds by the insane, it is well to remember that there is no accounting for the variety in the nature and extent of such injuries. Some wonderful examples of self-destruction in this class of persons are recorded in medical literature; in a few instances the object was accomplished by blows upon the head with a hatchet, axe, or hammer, or by forcing within the skull such implements as a chisel, awl, or pieces of wire, etc.

The mere situation, therefore, is only suggestive of the origin of a wound, since it is possible for a murderer to simulate a suicidal wound for the purpose of avoiding detection. When wounds exist in the back, or upon parts not within easy reach of the person himself, the presumption would be that the injuries are of a homicidal nature; but, as Orfila states, it is not so much the situation as the direction of the wound which furnishes proof against self-destruction. A wound passing directly through the body from behind forward would furnish presumptive evidence of homicide rather than of suicide, for the very reason that a person bent upon self-destruction would rather avoid than adopt such a complicated and uncertain method. Nevertheless, as stated above, it must not be overlooked that the most accessible parts of the body are often avoided by the would-be suicide.

Suicidal wounds, as a rule, are inflicted upon those parts of the body where they will produce rapid and sure results. Concealed wounds, or those which are located in parts which are not readily accessible, are presumptive of homicide, although, again, self-inflicted wounds are occasionally discovered in the most unusual places, sometimes for the very purpose of attributing them to another in order to raise the suspicion of murder. Such cases, however, are very rarely heard of.

The most common site for the infliction of incised wounds is in th and, as Woolsey observes, "they may sometimes be arrested by the especially if it be ossified, though the incision often divides the larynx situation of the wounds is often between the larynx and the hyoid bo then, meeting no bony resistance, they may often divide the great and even nick the vertebræ. But it is rare to be so deep, at least c sides at once. As a rule, it is deepest on the side on which it is and ends more superficially. As far as the situation of the wound cerned, there is no wound which a suicide can inflict but what ma flicted by a murderer. The reverse, however, is not true. We always certainly distinguish between suicidal and homicidal woun their situation."[1]

2. *The Nature and Extent of the Wound.*—As a rule, self-des is seldom the result of contused wounds, but usually of incised or pen (punctured) ones. But an exception must be made here, as wh example, a person precipitates himself from a great height; or, as lunatics, where suicide is accomplished by butting the head agains substance, such as a wall or floor, and subsequently hacking it with or similar instrument. In case the contused wound was self-inflic difficulty in clearing up the case is considerable. Taylor quotes a lated by a medico-legal writer in which a man attempted suicide by his head against a hard wall, but, having failed in this attempt, he fully accomplished his purpose by striking himself repeatedly on the f with a cleaver, thereby inflicting fatal injury to the brain. The cr witnessed by several by-standers. Had this not been the case, the n the injury was such as to be presumptive of murder.

Incised wounds of the throat are usually regarded as indica suicide; but it frequently happens that homicidal wounds are inflicte same locality for the purposes of concealment. Woolsey says, if the case, that homicidal wounds of this nature can frequently be differ from similar suicidal wounds, provided the victim was not asleep or or was otherwise incapable of defending himself, by the form and d of the wound, by its irregularity, and by other wounds on the hands of the victim. Thus, for example, if the nature of the wound in t indicated that it had been made by an incision extending from wit ward, like that made by butchers in slaughtering sheep, it would sumptive of murder. The *regularity* of the wound of the throat rather indicate self-murder than homicide, although, if resistance on of the assailed is impossible, the assailant may readily make a regu clean incision. On the other hand, the irregularity of a self-inflicted may be due to nervousness or hesitation on the part of the suicide.

The evidence furnished by the *number* and *extent* of wounds m be considered. Multiplicity of wounds, although indicative of homic

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicolog

ssible in self-murder. Krugelstein[1] relates the case of a woman found ng, who had on her head thirty parallel wounds one-half of an inch in gth. They were located on the vertex and forehead, and had penetrated outer table of the skull. In addition to these, parallel incisions were nd in the neighborhood of the heart, which, from their being in a state suppuration, must have been three or four days old. Maschka[2] gives case of an old woman who stabbed herself in the abdomen with a knife, n inflicted severe injuries on the head with an axe, and finally made an rt to open the veins in the elbow. The autopsy showed a large fracture ated on the right side of the os frontis. A man fifty-three years old, s Riembault,[3] first cut his scalp with a pocket-knife, then inflicted heavy ws on his head with a hatchet, and as a last effort hung himself. The opsy revealed a large fracture at the point of apposition of the parietal h the frontal bones, and nine distinct parallel incised wounds of the scalp. teen of this unfortunate man's relatives were insane. Kupfer[4] relates the e of a man, forty years old, who drowned himself after having inflicted er injuries. His history was that of overwork, anxiety, and a slight temary mental aberration. The autopsy showed thirteen parallel wounds of integument above and behind the right ear, some of which penetrated to bone. There were found over the left ear many wounds, with a large s of substance; in all, seventeen incisions were counted posteriorly and rteen anteriorly. The bone was considerably fissured and splintered. n Haumeder[5] furnishes the case of a hostler suffering from typhoid fever, o was found hung. A hole two inches in length and half an inch in adth, at the bottom of which the bone was exposed, was found at the tre of the vertex of the skull. Both of his hands were stained with blood, d at a short distance from the corpse lay a hatchet covered with blood, and l farther off, near a pool of blood, was a large hammer. Upon an examtion being instituted, it was discovered that at least sixteen blows were ected against the head, seven of which penetrated the skull. There was phus abdominalis in the ulcerative stage. The opinion of self-destrucn was based on the facts that the injuries were of comparative insignifince from the use of such large instruments; that the wounds were parallel each other; that they were all more or less bunched together; that there s not the least evidence of resistance; and that typhoid fever was present.

That multiple wounds are possible in suicide is evidenced from the citan of the above instances. If several equally *grave* wounds are found on the body, it is generally set down as presumptive of homicide, for it is usual for such wounds to be self-inflicted. The medical witness, however, ould not rest satisfied from this fact alone, for most wounds are not fatal stantly. It is obvious that if several wounds exist in a case of self-destrucon, one of these usually is fatal in character; but if two or more mortal

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[1] Wiener Medicinische Wochenschrift, No. xv.
[2] Ibid.
[3] Ibid.
[4] Ibid.
[5] Ibid., No. xviii.

wounds are found in different parts of the body of the deceased, or such as may be found in the region of the throat, where large vessels abound, a negative idea of suicide must prevail.

Woolsey states that a multiplicity of wounds in a case of homicide may afford evidence as to their origin from their situation or direction. He quotes Ogston as saying "that, especially in the case of incised wounds of the throat, a suicide may make a number of small or superficial tentative cuts besides the principal one; but these incisions are all usually parallel. In the case of multiple homicidal incised wounds of the throat, on the other hand, the wounds are not parallel, owing probably to the resistance of the victim in this case and his remaining passive in the former."[1]

As to the *extent* of the wound, we are to make note of the number and importance of the parts involved. It is commonly imagined, no doubt on account of the fact that most suicidal wounds of the neck are not deep, that an extensive wound of the throat cannot be made to involve all of the important structures in this region, clear down to the vertebræ, if inflicted by a suicide. Notwithstanding the fact that most of these deep incisions are homicidal in nature, instances are recorded where a person determined on self-destruction has made a clean sweep of the throat down to the vertebræ. Marc refers to a case of self-murder where the incision involved all the muscles of the neck, the trachea, the œsophagus, the jugular veins, and both carotids, while there were marks of the weapon even upon the anterior vertebral ligament. Such extensive wounds, therefore, are not incompatible with suicide, although, when connected with other signs, they are, as a rule, presumptive of homicide. "The question may arise in regard to a wound," says Woolsey, "*whether the victim wounded himself by precipitating himself on the weapon.* This may be alleged by the defence, but it is difficult to believe if the wound is deep, for the body would naturally repulse the weapon. If the wound is deep, the weapon must at least have been strongly held, which may or may not be consistent with the theory of self-defence. If the direction of the wound is oblique from above downward, or if there is one external wound and two separate tracks internally, from a second use of the weapon on the part of the person holding it, then the above allegation is doubtful, if not impossible. By comparing the relative positions of the deceased and accused, as indicated by the witnesses and accused, with the position and direction of the wound, we may often judge whether the allegation is possible or probable."[2]

3. *The Direction of the Wound.*—This will often enable the legal physician to differentiate between the suicidal or homicidal nature of a wound. In most incised wounds of the throat, inflicted with suicidal intent, it will be noticed that the direction is almost always from left to right, if the person be right-handed, while in punctured wounds it is most frequently from right to

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.
[2] Ibid.

left, and downward. The reverse prevails if the suicide be left-handed. Nevertheless, the extent and direction of such wounds are subject to so much variation that, without particular attention being devoted to surrounding circumstances, the possibility of generalizing with respect to them is doubtful. Woolsey says that transverse wounds of the throat without obliquity are consistent with suicide, although more frequent in murder, while wounds which have an obliquely transverse direction from above downward and from right to left in a right-handed person are evidence of their having been made by another. An incised wound of the throat, inflicted from behind by another person, may bear the same direction as similar suicidal wounds if the victim and assailant are right-handed, or from the left side if they are left-handed. Such wounds may be purposely made by the murderer to simulate suicide. The direction of a homicidal incised wound of the neck, inflicted from in front, is usually the reverse of a similar suicidal wound. Homicidal incised wounds in this situation may be prolonged beyond one or the other extremities of the skin-wound, while in similar self-inflicted wounds the skin is the first and the last part injured, at both angles of the wound, and in such injuries the weapon scarcely reaches the vertebræ, although the faculty which some suicides possess of using both hands with equal facility must not be overlooked.[1] In the case of Hanson, which came under the observation of the writer, the man was always believed to be left-handed, although his ante-mortem statement elicited the fact that he fired three shots into the right side of his head.

In the case of homicidal wounds the direction may be the same as those which are self-inflicted, but they are produced while the assailant stands behind or to one or the other side of the victim. In suicidal stab-wounds of the chest the injured part is most frequently located upon the front or side of the body, while its direction, if the person be right-handed, is obliquely from above downward, and from right to left, while the converse holds true if the suicide be left-handed. If a stab-wound, inflicted with murderous intent, is from in front, then its direction, as a rule, is from left to right, and it may be from above downward, or the opposite. All oblique wounds from above downward are common to homicide and suicide, but those which have a direction from below upward are generally presumptive of murder.

If a wound is the result of a cutting or puncturing instrument, the probability of suicide cannot be entertained, unless the weapon be placed in one or other of the hands of the deceased and the extremity moved toward the wound to see if the direction of the latter could possibly correspond to it in any position. If the arm moved cannot possibly reach the wounded part, it becomes obvious that it was not self-inflicted.

Evidences from Circumstances.—(1) *The Position of the Body.*—(*Vide* Medico-Legal Autopsies.) In cases of immediate death from hemorrhage, the body will usually be found in the supine position; but if the death be

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

less rapid, it will occupy a prone position. A suspicion of murder could be entertained if the deceased was lying in the former-mentioned position, while the weapon was found at a distance from it, although, as previously stated, suicides sometimes try to simulate homicide by throwing the weapon away from them, as has been known to occur.

(2) *The Position of the Weapon.*—This in relation to the body of the deceased may be of considerable importance as regards the question of homicide or suicide. If it be tightly gripped by the hand of the deceased, the presumption is strongly for suicide; but if it be found at a little distance from the body, the physician must consider whether it might not have dropped to the place or been thrown there by the dead person, as previously stated. If the body has in any manner been disturbed or moved, the relations existing between it and the weapon will be inadmissible as evidence. Taylor cites a case, which was referred to him, where a woman had died from a homicidally made wound of the throat; a razor, the weapon employed, was discovered under her left shoulder, a somewhat unusual position, but which, it seems, it had assumed owing to the turning over of the body previous to the visit of the physician. The following case, reported by Dr. J. B. Lewis, remarkable alike in the position of the weapon relatively to the body of the deceased and the evident desire of the suicide to simulate homicide, is quoted from Dr. Lewis Balch's contribution ("Homicide and Wounds") to Hamilton's "System of Legal Medicine": "Captain Colvocoresses, a retired officer of the United States Navy, was found in a dying condition in a by-street in Bridgeport, Connecticut, at a late hour of the night of June 3, 1872. The captain, although possessed of small means, obtained insurance upon his life for $195,000. He was ostensibly on his way to New York from his home in Litchfield when his death took place in Bridgeport. He had been to the boat, secured a room, left in it his travelling-bag, but as the boat did not leave until eleven o'clock at night, he left it to go to a hotel and get some supper. When going off the boat he was seen to carry a small black bag and his cane. This latter was a bamboo sword-cane. After getting something to eat at a restaurant, he idled away his time until half-past ten, when he left a drug-store, where he had made some small purchases of paper and envelopes, and being directed how to find the boat, he apparently started to reach it. Just as the boat was putting out the report of a pistol was heard, and a policeman, of whom the captain had earlier in the evening asked some questions, hearing the shot, ran to the place from where the sound had seemingly come. Lying on the sidewalk, and in a dying condition, was Captain Colvocoresses. A large gunshot wound was in the left breast, his left hand pressed against it, and he was on his back. The discharge had set fire to his shirt, and the light from it guided the policeman. In a diagonal direction across the street, in the gutter, was an old-fashioned, percussion-lock horse-pistol. This weapon had evidently just been discharged. The sword-cane was about two yards from the captain's feet, and toward the gutter. The cane was broken, and the blade in it bent.

n examination it had the appearance of having been broken by being :k or snapped over a fence. The bullet had gone completely through body. First one thing and then another was brought to light. A pill-, having percussion-caps which fitted the pistol, was discovered. A boy, ng a bit of rag sticking out from under a gutter-plank, carelessly pulled it, and with it an old powder-horn. Tiring of his plaything, he threw it re it was afterwards found. The black bag carried off the boat by the tain was found on another wharf, partly hidden under a railroad-tie. end was slit open, and nothing was in it but a blank check-book and te few grains of powder, which, on comparison with the grains in the rder-horn, were shown to be similar. Peculiar indentations were noticed he bag, and trying the pistol, these were seen to correspond to the point ere the hammer would rest if the pistol was put into the bag. The cap-n's coat and waistcoat were unbuttoned and lay open when he was found the sidewalk. It was proved that he habitually wore his coat buttoned , and while it was supposed that the opened clothing was a sign of vio-ce on the part of footpads, the buttons were not torn off either garment. e evidence of the wound was that of close fire. The discharge must have en fairly near, or the shirt would not have been set in a blaze. And the refully-cut satchel, the peculiar weapon,—the peculiar manner in which the ord-cane was broken, the evident care with which the percussion-caps and wder-horn had been hidden, the repeated questions by the captain in the rly evening of the way to the boat (although he was well acquainted with e town), the motive for death (that his family would be left in affluent cir-mstances), the peculiar manner of his bidding good-by to the family when aving home that morning,—all brought the positive conclusion that this as a case of suicide and not of homicide." Dr. Balch says that Dr. Lewis, in s report, "says, the pistol being found thirty feet away was accounted for y the recoil of the weapon, the pistol springing back from the chest after it as fired. I am inclined to differ from this view, and would rather think it n act of volition. All the evidence points to so carefully conceived a plan at some arrangement must have been thought of by which the weapon ould be found a distance from the body. Therefore, I do not think it in-ompatible with the wounding that the captain could throw the weapon. he recoil may have helped in this, the arm giving the sudden jerk prede-ermined on, and both forces combined carrying the pistol thirty feet."

Taylor refers to a case where the deceased was found in bed with a deep wound in the neck, and the weapon—a razor—lying shut by his side; and Casper mentions the case of a man dead with a gunshot wound in the reast, while the pistol was afterwards found in his pocket. It is scarcely robable that a suicide could have inflicted either of the above wounds, nuch less perform the acts of volition referred to. Most frequently in case f suicide the weapon is found lying by the side of the deceased, or, as lready mentioned, it is tightly grasped in the hand. The latter appears to e due to the muscular spasm which continues after death (cadaveric spasm)

until rigor mortis manifests itself. Casper says that this state cannot be imitated by a murderer or other person who might place the weapon in the hand of the deceased for the purpose of avoiding suspicion, since the powerful muscular contraction which exists at the moment of death is lost, and the weapon falls from the dead man's hand. These circumstances, while strongly suggestive of suicide, are not infallible marks of distinction between this class of wounds and those of a homicidal nature. The weapon in the hand of the deceased may have been there for use in case of defence; therefore, it becomes the duty of the legal physician to ascertain whether there is any degree of correspondence between the wounds on the body and those which might result from the use of the weapon.

Another important point for consideration is that the weapon found by the side of the victim's body may have belonged to him and been substituted by the murderer for the one which caused death. Hence it is important to note whether it can be adapted to the wounds as to length, depth, etc., to be suggestive of suicide.

When the attempt at self-destruction has been unsuccessful, a second or even a third attempt may be made to end life. In such cases the suicide may employ another weapon instead of using the same one over again; therefore, two or more wounds made by the same or different weapons cannot be absolute evidence of homicide. (*Vide* Presence of More than One Wound.)

(3) *Blood, Hair, etc., upon Weapons.*—The appearance of blood, hair, etc., on the weapon is a matter of great importance in the consideration of suicidal or homicidal wounds; although a weapon may be used to inflict a mortal wound, and still be free of blood or other substances. In stab-wounds, the weapon, on being withdrawn from the wound, may be cleansed against the sides of the wound in the integuments and by the clothing. In this manner it may appear perfectly clean except for a thin yellowish film. This fact serves to explain the reason why the stab-wound first inflicted leaves no blood on the exterior of the clothes worn, but only on the inside. Balch[1] says that "stains upon the blade of the weapon are not always the only spots that may be found, and every particle of the weapon should be carefully searched and tested before stating that no blood is on it. Where a fixed handle is present, if it is made by two pieces of wood, bone, or other substances, being riveted to an extension of the blade, the rivets should be drawn, and every particle of dust or foreign substance found be examined in all the ways known for testing blood. The same where the knife is a clasp-knife. Blood may have been plentifully spread over the blade, and the knife carefully washed by the criminal, and still blood be found in the cracks under the handle pieces in the hinges, and prove an important link in the chain of evidence. Fire-arms are not so apt to be marked by blood. They may be used, however, in clubbing, where the noise of the discharge would

[1] Hamilton's System of Legal Medicine.

be liable to bring about discovery. The same condition may then be found as is noticed where blunt weapons are used, and the blows struck cause more r less bleeding. When the weapon is wood, the blood makes its mark eadily, and can be studied in the same way as blood upon cutting instruents. If the bark is still on the club used, then blood will be found clotted n the interstices of the bark, and may be more readily detected. The eapon may be a stone and blood be found upon it."

If blood is not found on a weapon, *hair* and the *fibres* of various sorts f fabrics should be looked for. Such substances, however, when found on weapon associated with blood, often afford the strongest presumptive evilence of murder or violence. This is especially so if they are found to corespond with similar fibres taken from articles of clothing worn by the leceased at the time of the murder. When hair is discovered on a weapon, he question naturally arises, Is it the hair of a human being or of an animal? Here the hair or fibre should be removed for the purposes of microscopic examination. (*Vide* Hairs and Fibres.) This will also determine whether it has been cut or broken by a blow. If the hairs are discovered embedded in blood on a weapon that has been used with homicidal intent, the aid of a good magnifying glass will be of material assistance before subjecting them to more thorough treatment. In the recent Cronin case at Chicago, the subject of hairs in connection with blood-stains came before the court. Dr. William T. Belfield testified as to the results of examinations of certain specimens of blood, hair, cotton, etc., furnished him by the authorities in connection with the case. The doctor testified that he received some cotton and subjected the liquid portion of a red substance with which it was found associated to examination. He found that it was blood, as demonstrated by the corpuscles. In reply to the question, What examination did you make of the hair? the doctor stated that he examined single hairs in each of the two bunches, in reference to their length, diameter, and structure. The results of his examination (six hairs from each of the two bunches) proved that they were all human. Richardson[1] mentions the case of a little girl, nine years of age, who was found lying on the ground in a small plantation, dead, with a wound in the neck. The mother of the child was arrested on suspicion of having caused the death of her child. Her manner and behavior betrayed her to a certain extent, and she admitted that she had taken the child to the plantation, but that it had wandered away and was lost while hunting for flowers. A large knife was found in the woman's possession, but nothing was found upon it, however, but a few pieces of hair adhering to the handle, so small as to be hardly perceptible. To the remark, "Here is a bit of fur or hair on the handle of your knife," the suspected woman replied, "Yes, I dare say there is, and very likely some stains of blood, for as I came home I found a rabbit caught in a snare and cut his throat with the knife." The knife, together with the particles of hair, was

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[1] Medical Microscopy.

submitted to a microscopic examination, with the following results: "] trace of blood could at first be detected upon the weapon, which appea to have been washed; but upon separating the horn handle from the sh it was found that a fluid had penetrated into the socket which was found be blood, certainly not the blood of a rabbit, but bearing a resemblanc that of a human body. The hair was then submitted to examination. hair was found to be that of a squirrel. Now round the neck of the chi the time of the murder there was a tippet of squirrels' fur. This st circumstantial evidence was deemed by the jury sufficient to convict prisoner, and while awaiting execution she confessed her crime."

Besides the medico-legal questions already referred to in connection hair (*vide* also Hairs and Fibres), the following must be considered by legal physician,—*i.e.*, Does the hair correspond with that of the murder of the victim, and has its color been naturally or artificially changed?

(4) *Evidence from Blood-Stains.*—In medico-legal cases the phys should not only make a careful external examination of the body of dead person, and note anything and everything that might throw upon the cause or mode of death, but he should also, where possible, particular attention to the surroundings where the victim was found. reference to the clothing on the prisoner at the time the crime was pe trated, all evidences of stains from blood should be carefully studied.

The value of noting carefully the form and direction of blood-spots thrown from a vessel is well illustrated by Taylor[1] in his remarks sugg by the Reg. *vs.* Spicer case. He says, "At the top of the stair, and a height of four or five feet above the level, several spots of blood were served upon the brick wall, which was whitewashed. The spots too oblique direction from above downward; were of a pale red color at upper part, but dark red below, terminating in a point consisting of fibrin and the greater part of the red coloring-matter. Their form[2] regularity proved that they had proceeded from a small artery, and tha wounded individual could not have been very distant from the wall, their shining lustre rendered it probable that they were of recent origin, their well-defined termination in a firm coagulum showed that they proce from a living blood-vessel. The deceased had died from fracture of the and vertebral column, by a fall from the top stair; one branch of the temporal artery was found divided, and this wound could not have produced by the fall. It was, therefore, evident that a murderous as had been made upon her at the top of the stairs; this had led to the spir of the arterial blood on the brick. The height at which the spots exi and their appearance proved that the jet of blood had been from al

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[1] Medical Jurisprudence.

[2] The *form* may serve to differentiate between arterial and venous blood, s arterial blood assumes an oval or elongated shape when thrown in a jet fron divided vessel.

ard, thereby rendering it probable that the deceased was standing up, her head was raised at the time the wound was inflicted. Further, as k with the spots was on his right side, it is probable that the deceased e to face with her assailant in the act of ascending the stairs, and that killed by being precipitated to the bottom." (*Vide* Examination d-Stains.)

important to notice how the blood escapes from a wound; and, h the greatest amount of blood will be observed to be near the or the place where the victim has died, still it is well to remember deceased may have moved about considerably, a fact which would for the blood-stains often discovered on clothes, furniture, or other at a distance from the dead person. Balch mentions the following 'In November, 1870, a man cut his throat in a hotel at Burlington, t. The fact was discovered about nine o'clock in the morning. ing to be in the house and hearing the alarm, I went up to the room ed the following : the man, still alive, lay on the floor, about four feet window of the room and about eight feet from the door. Between l the door there was a pool of blood about the size of an ordinary Another clot was under his neck, not so large as the first. Two ne longer than the first named, were between the body and the . By the window was a rocking-chair, and in front of it a tin pail, the position one would place it if it were set between the legs of one n the chair. Blood was in the pail, all over it, and on the carpet. vidently, the greatest amount of blood was lost, and here the suicide his throat, intending to bleed quietly into the pail ; but nature was e denied, and he moved about, bleeding awhile here and there until xhausted. All hemorrhage had ceased when he was found. In the l was found the razor with which the wound was inflicted. These been rapidly noted, the man was put on the bed and the wound ex- The cut was not deep, did not involve either carotid, was between oid and thyroid cartilages, and the only vessel that could be found was the cricoid-thyroid artery. How such an amount of blood ave come from this small vessel seemed a mystery ; but there was no ound, and no other place from which the blood could have come. esulted in the evening, the man not rallying from the shock and loss l. Blood was on his right hand and in front, and it was concluded other blood-stains were probably gotten when he fell and tried to falling and rolling over, until he lay quiet in the position he was ."[1] The importance of noting the manner in which the blood exudes wound will sometimes show the position of the wounded person at of the wounding. If the wound be in the throat or the chest, the nces indicated by the flow of the blood may serve to demonstrate the injury was inflicted when the body was in the erect, sitting, or

[1] Hamilton's System of Legal Medicine.

recumbent posture. Therefore the course which the blood has taken may serve to differentiate between a suicidal and a homicidal wound. Thus, if the throat or the chest is the part involved, the course of the blood may be down the front of the body, or it may be found on each side of the neck down to the armpits. If the blood be found in the former locality, the assumption would be that the body was in the erect position at the time the injury was inflicted; the collection of blood along the sides of the neck and close to the armpits, as in the second instance, would indicate the recumbent position at the time the throat was cut. It is important, in this connection, to bear in mind that very few suicides cut their throats while lying down, and also that the discovery of recent wounds on the back of one or both hands in cases of death from throat-wounds is, other things being equal, suggestive of homicide, although, as Taylor remarks, these may be absent if the circumstances were such as to preclude the possibility of defence on the part of the assailed, such as where the assault was of sudden origin, or if the deceased was under the influence of liquor, or had been rendered powerless by the combined efforts of accomplices in the crime.

It is proper to examine the clothing of the deceased, and, if possible, that of the person accused of the crime, for blood-stains. If any blood be on the clothing of the dead person, the examiner should make note of the amount, —that is, whether it is merely sprinkled over the garment or exists in large patches. (*Vide* Form and Direction of Blood-Spatters.) The importance of examining the dress, etc., of the accused for blood for the purposes of microscopic examination has already been referred to. (*Vide* Blood-Stains.)

If the deceased has committed suicide by a weapon similar to a knife, it is usual for the hand to have blood upon it, although its presence is by no means always presumptive of self-destruction; while its absence may negative it, since blood on the hand may result from homicidal wounds.

The finger-nails of the suspected person may reveal the presence of blood, etc., underneath when all evidence of its presence elsewhere is wanting. This form of evidence in the "Frenchy" case, before referred to, was very marked. The account of the accused as to the origin of blood on his person or clothing may or may not tally with the facts as shown by them. In the case of Adolph Reich, in which the writer furnished expert evidence, the spots and large patches of blood found upon his person and clothes (his shirt, drawers, and stockings were covered with the fluid) were stated by the prisoner to be the result of a nose-bleed on the part of his wife, whom he was subsequently found guilty of having murdered. His wife was found lying in a pool of blood, at her residence, with an incised wound of the throat which extended from ear to ear, and involved the trachea, carotid artery, œsophagus, etc. Here the account of the prisoner as to the origin of the blood upon his clothes, etc., did not agree with the facts as indicated by the surrounding conditions.

Acts of restlessness on the part of the wounded person, such as moving about from one room to another, may be indicated by the discovery of blood

distant objects, a fact which has already been alluded to when considering e case of suicide cited by Balch (*vide* p. 295); but in connection with ese acts the writer wishes to emphasize the importance of noting whether ere are any communications in blood between these different places.

Is it possible for the assailant to escape without being spotted with blood? he person who inflicts the wound may escape without blood-stains in certain ses. Thus, in the case of lacerated and contused wounds hemorrhage is ot always an accompaniment of the injury, while in punctured wounds the leeding is not so extensive as is the case in incised wounds; moreover, ey are less likely to spirt. The copious effusion of blood that follows cised wounds may be avoided by the assailant if he stands behind or to ne or the other side of the assailed when he inflicts the wound. The resence of multiple wounds renders it more difficult for the assailant to void being contaminated with blood. The absence of blood on the clothing f the murderer is often offered by the defence as sufficient proof of the nnocence of the accused. The fact must be remembered, in such cases, hat the suspected person may have changed or washed his clothing previous to the examination. Also, as Woolsey states, "that blood-stains may be found on the clothing of many, especially on the coarse clothing of working-people. This may be accounted for by the occupation, flea-bites, accidental circumstances, or it may occur without definite explanation. Such persons may be accused of murder and yet the blood-stains be consistent with innocence."[1]

(5) *Foreign Substances in Wounds.*—These, such as grass, dirt, hay, portions of dress, parts of the weapon, etc., may assist the examiner in tracing the person guilty of the crime. In the Reich case the writer discovered a small piece of wood in the neck-wound which belonged to the handle of the knife that caused the wound. (*Vide* Gunshot Wounds.)

Signs of a Struggle.—The evidence to be derived from these signs is of great importance. If a knife or similar weapon produced the wounds, the signs of struggle may be shown by cuts on the fingers or on the palm or back of the hands. Such injuries are seldom self-inflicted. In the above-mentioned case (Reich) the injuries found upon the body of the victim showed that the woman fought desperately for her life, having grasped the weapon several times before it was sunk into her throat. The autopsy, which was made by the writer, revealed three cuts on the fingers of the right and two on the fingers of the left hand, all of which reached the bone. Other signs which go far to prove homicide are the contusions or ecchymoses sometimes seen on the face, neck, chest, forearm, or hand of the victim. These generally indicate the form of the foot, fist, fingers, or fingernails of the assailant. Again, if marks or scratches be found on the person of the accused, they may be of great assistance in fixing the crime where it belongs. Thus, in the following case, which is quoted by Reese ("Medical

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

Jurisprudence") from Gaillard's *Medical Journal*, 1888, much important ev dence was furnished by similar signs. "A dreadful murder occurred in Par some years ago, in which the throats of three women were cut after seve struggling, and the bedding and walls of the apartment were copiously b spattered with blood. A man named Pranzini was arrested for the crim but the closest examination of his clothes revealed no blood-stains up them. This, of course, was relied upon as a strong point by the defen But M. Brouardel recalled the fact that in the adjoining room he had notic a basin containing much bloody water, indicating the washing of a per stained with blood, and this person could only have been the murde Hence Dr. Brouardel conceived the idea that the criminal, in order to av the risk of being stained with blood, had first stripped himself of his g ments and then committed the murders in a state of nudity, after which had washed and resumed his clothes, and so hoped to escape detection. Brouardel asked to examine the prisoner completely stripped, when a lo tearing scratch was found extending down the front of the right thigh. terrogated upon this, the criminal declared he had been attacked by a sev itching, to relieve which he had torn himself in scratching. Being invi to repeat the gesture, he did so, upward from the knee toward the b (as was natural); but the medical expert showed that the tear had b made by nails, or some sharp body, *from above downward*. Doubtless assassin approached his victim with the weapon in his right hand, and w his right side exposed, and so received the scratches on his right thi The criminal was condemned and executed." Frequently the impress of a dirty or bloody hand, or some of the fingers, may be found on clothing or person of the victim, where it would have been impossible the deceased to have made it, notwithstanding the fact that either one of hands, or both, were bloody. Such a condition would indicate a strug with an assailant. If there be marks of violence about the mouth of dead person, such as may arise from a desire on the part of the assailant prevent an outcry from the victim, the evidence of such would be presumpt of murder. Furthermore, an examination of the clothing of the victim assailant often furnishes signs of a struggle. (*Vide* Surrounding Obje and the Position of the Body; Examination of the Body before the Clot are removed; External Examination of the Body; Foot-Prints, etc.)

Imputed or Self-Inflicted Wounds.—These will be discussed in a sub quent chapter. (*Vide* Feigned Diseases, etc.)

Accidental Wounds.—*Was the wound the result of accident?* T determination of a question of this nature depends for its elucidation on t consideration of those points which serve to distinguish suicidal from hom cidal wounds. The question is often of great consequence in a trial homicide, as the defence may claim that the injury was not the result of assault by the prisoner, but was occasioned by accident. Furthermore, th may allege that the wound was due to suicide.

(1) *Accidental and Suicidal Wounds.*—The nature, situation, and dire

tion of the wound may often serve to distinguish between accidental and suicidal wounds. The former class of wounds are most commonly the result of contusion, while suicidal wounds are not or are rarely so, as in cases of insane or delirious persons. Accidental wounds are most frequently situated in exposed parts, except in cases where the injured person falls from a height, when the wound may be in almost any part of the body. The direction of the wound is of little consequence in wounds of an accidental nature, since it is only of importance in wounds which result from a sharp or penetrating instrument, which are seldom due to accident. Severe punctures and stabs in vital parts, occasioned by accident, have occurred. They are generally the result of falls, as where, in the act of running with a puncturing instrument in the hand, the person slips.

(2) *Accidental and Homicidal Wounds.*—The distinguishing marks between accidental and homicidal wounds are summed up as follows by Woolsey.[1] "(1) The evidence from the nature of the wound is not quite so conclusive as when the question lies between suicide and accident; for contusions and contused wounds are far more often homicidal than suicidal, and accidental wounds are almost always of this class. If, however, the wounds are incised or punctured, this fact points almost certainly to homicide. (2) As to situation, a homicidal wound may be situated almost anywhere; an accidental wound, except in falls from a height, only on an exposed place. (3) The direction of the wound can seldom help us in the case of contused wounds, which practically are the only ones in question, though it may possibly be incompatible with accident. (4) As to the number of wounds: homicidal wounds are more apt to be multiple, either in a small area or scattered in such a way that an accident could hardly account for them all. (5) A weapon may give evidence more often here than when suicide is in question, for a weapon may be used to inflict contused wounds which resemble those received in a fall. The evidence furnished by a weapon, or blood, hair, etc., on the weapon, etc., is strongly in favor of murder. (6) The evidence from a struggle is also more important, because it is more often found. A struggle may occur in homicide, and only in homicide, as a rule, so that the signs of a struggle are strong evidence of murder and against the idea of accident. (7) The examination of the clothes and body of the deceased may give valuable evidence, showing, as it may, signs of a struggle or other marks of an assailant, and indicating murder. (8) Examination of the position and attitude of the body, and of the spot where it lay, and the ground around may furnish more or less proof of murder."[1] (*Vide* Suicidal and Homicidal Wounds.)

Presence of More than One Wound.—When two or more wounds are present on a dead body, either of which was fatal, the question may arise, *Which was first inflicted?* It is extremely difficult to furnish a direct answer to this question. If but one of the wounds is mortal and the others

[1] Medical Jurisprudence, Forensic Medicine, and Toxicology.

not, there can be no question as to which was inflicted first; but if the wounds have been inflicted simultaneously, as where the victim has been attacked by two or more persons, no certain answer can be furnished, nor can any definite reply be given as to which wound caused death, if more than one be fatal. If other evidence than that of the injuries themselves be presented, then the question may be answerable with some degree of certainty.

Could a person inflict upon himself consecutively two wounds, either of which is sufficient to cause death? In answer to this question, Reese says, "We think there can be no question about the possibility of the self-infliction of two mortal wounds, provided the first one was not instantaneously fatal. It is well known that a stab or bullet through the heart or a pistol-shot through the brain is not immediately fatal, so that ample time is allowed for the repetition of the fatal act on the part of the suicide. Moreover, it is within the bounds of probability that, after the first fatal shot from a self-cocking pistol, a second discharge from the weapon may have been a mere automatic act,—the victim's finger being at the time on the trigger, and thus producing the discharge unconsciously. It might even happen that this second unconscious and chance shot might produce a fatal wound upon another person, and thus give rise to the question of an intentional or accidental homicide." [1]

Speaking of *suicide* in general, the following remarks, extracted from a recent article [2] by the writer, as to the alarming increase, causes, and methods of self-destruction, will be of interest. The rate of suicide in this city has been for some time past abnormally high. The community has been passing through a long period of commercial depression, and many take their lives on account of absolute hunger or in despair of ever knowing prosperity again. The sudden heat of the spring season also destroys the balance of many minds. There was an average of four suicides a day in this city for a week recently. Men, as usual, committed suicide much more frequently than women, and during the period of abnormal suicidal tendencies the proportion among the males has been even larger than usual. Suicides in New York are more numerous among persons between the ages of twenty-five and thirty-five. The average rate of suicide among men as compared to women is three to one. The proportion of men to women among elderly suicides is still greater. The fact must be considered that women are in excess of men.

The *causes* of suicide, in the order of their importance, may be given as follows: domestic troubles, reverses of fortune, sorrow, physical suffering, insanity, and the weather. In New York City in 1880 there were one hundred and fifty-two suicides, being 12.59 per one hundred thousand. In Philadelphia the rate was 8.03; in Boston, 11.03; in San Francisco, 33.65.

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[1] Medical Jurisprudence.

[2] Suicides in New York, 1894, Justin Herold, A.M., M.D.

will be seen that San Francisco shows an enormously larger percentage than any other city, but New York comes first among the Eastern cities. The health records of this city from October to March last show a total of one hundred and seventy-five cases of suicide, or sixty more than during the preceding six months. The average yearly number of suicides for the past five years was one hundred and twenty-two. The increase of the last six months is therefore very great. Although special causes contributed to this increase, it is probable that the proportionate number of suicides will steadily grow larger with the growth of the population. In September, 1893, there were forty-two suicides, that number being the highest record of recent years.

Poisoning is the favorite method of suicide in this city, and Paris green and morphine are most frequently used. After poisoning, the commonest methods in the order of their popularity are shooting with a pistol, hanging, throat-cutting, stabbing, and drowning. Poisoning has always been the favorite method of suicide with women, but it is being generally adopted by the male suicides of this city. This is possibly an indication of a general tendency to feminization in modern society.

There are less suicides among the cheerful and religious Irishmen than among any other nationality. The German race, with its predisposition to melancholy and metaphysical speculation, furnishes the largest number of suicides. The temperament of the colored man is a happy one, and statistics show that in this city one colored man commits suicide to every thousand white men. The small number of the colored people must, of course, be taken into consideration.

Many curious cases of self-destruction have come under our notice. Among recent suicides the youngest was twelve years of age and the oldest ninety-two. In 1891 a man attempted to commit suicide by thrusting a teaspoon down his throat, but did not succeed. Physicians headed the list of suicides in that year, and have done so for ten previous years.

German maidens have not infrequently soaked matches in beer. It takes two boxes of matches with plenty of phosphorus on them to supply sufficient poison, and the beer cannot retain a trace of its agreeable flavor.

Suicides in this city are frequently the result of alcoholism. Although poison is a favorite method of suicide among women, those who drown themselves or jump from windows are almost exclusively women. Suicide is most common in May and June, the pleasantest months in the year. In unpleasant weather the rate of suicides is at a minimum.

The daily number of self-destroyers in France averages twenty. In the United States statisticians show that the average of suicides committed daily far exceeds that number. Some reliable observers say that the increase in this country has been marked ever since the great financial troubles in 1873. In France, from the year 1827, the annual average has risen from 1500 to upward of 6000, the number in 1851 having been 3639, or in the proportion of one suicide for every 9833 inhabitants, while in the year 1879 there

were 6496 suicides, or one for every 5681 inhabitants. That this increase of seventy-eight per cent. is not alone peculiar to France we see by glancing at the reports concerning Prussia and other countries. In Prussia, from 1873 to 1877, the increase was fifty-three per cent., and in Bavaria sixty per cent. In Belgium the proportion per million people was from sixty-six in 1860 to 1870 to eighty-one in 1875; from seventy-four in 1865 to one hundred and forty in 1877, in Austria; from thirty in 1874 to forty-one in 1877, in Italy; from twenty-three in 1872 to thirty-five in 1876, in Russia; from two hundred and thirty-three in 1874 to two hundred and fifty-seven in 1876, in Denmark; and in England, from 67.2 in 1866 to 69.2 in 1877. The proportion of suicides in the different countries of Europe is eighty per cent. of men to twenty per cent. of women. Morselli, in his work "Il Suicido," holds that more women proportionately commit self-murder in the country than in the cities. M. Bertillon states that widowers and bachelors are the victims more frequently than married men.

As to the mode of committing the act, the following figures show the proportion per one thousand in four of the principal countries of Europe:

	England.	Prussia.	Belgium.	Switzerland.
Hanging	368	608	545	430
Drowning	208	182	228	267
Fire-arms	46	109	118	70
Stabbing	206	54	39	67
Poisoning	94	30	23	33
Falling	94	9	15	11
Suffocating	94	3	4	13

The percentage of the modes of committing suicide in France is as follows: by hanging, forty-five per cent; by drowning, twenty-nine per cent.; by shooting, eleven per cent.; by suffocation, seven per cent.; and three per cent. by jumping from high altitudes. Suicide by drowning was the most frequent form of self-destruction in France forty years ago, being more frequent in the summer than in the winter months.

To-day statistical reports confirm the fact that suicide is common at all periods of life, even in childhood. Without doubt the greater number of cases occur between the ages of twenty and thirty years, though the years preceding and immediately succeeding the age of puberty show a slight increase, as do the years immediately preceding the fiftieth. Suicide is comparatively infrequent up to the age of fifteen, but there can be no doubt that the idea of self-destruction enters the heads of the young. There are cases on record of children who have committed suicide because teachers have been inclined to censure or punish too severely. Children are quickly hurt in their moral sensibilities. They have been known to commit suicide in passion as well as in sorrow. A case is reported of a boy who committed suicide because his mother refused to buy him a squirrel to which he had taken a fancy. Another did so because he was sent supperless to bed for

ving broken his mother's watch. He felt particularly hurt; while he was rays punished for his misdeeds, his sisters were generally overlooked. nother destroyed himself because his bird died, and another because he s twelfth in his class.

The number of suicides is greater among educated than among illiterate ople. This is a rule to which there is no exception anywhere. Self-murrs are more prevalent among Protestants than among Catholics or Heews; and Wagner, whose researches in regard to the causes of suicide are ost reliable, states that in Prussia, out of a population of one million ople, there are 159.9 suicides of Protestants as against forty-nine of tholics and 45.9 Hebrews; in Bavaria, 135.1 suicides of Protestants as ainst 49.6 Catholics and 45.9 Hebrews, etc. It may be mentioned that in untries which are purely Catholic suicide is at the rate of fifty-eight to the llion; in countries where the people are both Catholic and Protestant, nety-six to the million; and in purely Protestant countries, one hundred nd ninety to the million.

Trashy novels and all kinds of unwholesome sentimental literature are very important predisposing cause to suicide in this country. They produce a morbid condition of the mind which unfits people for realities. Facts re the most wholesome food for the mind. The thought of impending llness from hereditary disease is also a common incentive to self-destruction.

To check the increase in the rate of suicide in this community the exciting motives should be sought out and counteracted, as far as possible, even by a resort to unusual measures, and the duty belongs to the sanitary government of the State.

Cicatrization of Wounds.—Questions relative to the time at which the wound was produced, or to the responsibility of the accused person, may often be determined by an examination of the injury or its cicatrix.

A simple incised wound of no great extent cicatrizes in from fourteen to twenty days,—that is, the process is complete within that period of time. The rapidity of cicatrization is dependent on the situation of the wound, its extent, nature, and the age and health of the wounded person. Wounds of the lower extremities are slower in healing and cicatrizing than wounds of the upper parts. If the wound be near a joint, where the absolute rest of the parts cannot be insured, cicatrization is retarded. When the wound involves several structures, or if the latter be complicated, the process of cicatrization is less rapid than in those wounds affecting merely the skin and muscles. In those cases where the injured parts are contused and lacerated, or where loss of substance prevails, healing takes place by granulation, and the process occupies a considerable length of time.

Cicatrization of wounds in the old is less rapid than in the young. It is retarded in those who are suffering from disease or who are infirm.

The cicatrix of a recent wound, if incised, is generally straight and regular; if the wound is contused by nature, the attendant scar will be oblique. In appearance it is soft, tender, and redder than the surrounding skin; but

in the course of a month or two it assumes a harder consistence and becomes less tender and of a brownish-white color. Of course these changes are dependent on the circumstances already alluded to. The cicatrices of incised wounds are not always linear, since, on account of the elasticity of the skin and the convexity of the surrounding tissues, they often appear more or less elliptical. The process of cicatrization is always, to a certain extent, influenced by the state of the edges of the wound in the living body, which are greatly separated in the centre of the injury. But when the wound is so situated that it lies in a hollow surface or on a loose skin, such as exists in the axilla or groin, its cicatrix may be linear. Irregular scars are found in those parts where the wound is lacerated or contused, in which case they have a puckered appearance, with an irregular skin surface. Oblique wounds generally produce more or less semilunar cicatrices, while those occasioned by stabs are mostly triangular in shape.

Tidy says,[1] "Given a hard, *white*, glistening, non-sensitive cicatrix, although it is difficult to give a positive opinion whether the original wound was inflicted six months or six years before, a negative opinion may safely be given that the scar did not result from a wound inflicted two, three, or even four weeks previously. Given a *brown* cicatrix, we are scarcely in a position to give a very definite opinion. Given a soft, *red*, tender cicatrix, we may say that the chances are against its being of long standing. The various influencing conditions (such as age, the health of the patient, the probable extent and nature of the wound, etc.) must in such cases be carefully considered. It will be evident, from what we have said, that it is very difficult to fix the date of a wound merely from the appearance of the scar. But if a description of an alleged injury, of the instrument causing it, and of the date when it was said to have been inflicted be referred to the medical jurist, he should in most cases be able to say if the appearances presented by the cicatrix be consistent or inconsistent with the alleged cause and date."

Is a cicatrix always a result of a wound? A cicatrix is always produced by a wound involving a loss of substance. Very minute scars often follow incisions which are produced by sharp instruments. This is especially so in those cases where the direction of the fibres of subjacent muscles corresponds with the line of incision. These cicatrices are even and linear.

It is well to remember, in this connection, that if the skin be white such scars may be entirely overlooked, since they are always more distinct in dark skin. Such slight wounds as pûnctures by needles, etc., the prick of a lancet, or the bite of a leech, where the surface of the skin only is involved, frequently leave no scar at all. Tidy[2] says that the epidermis alone may show the cicatrix, while the cutis remains unaffected. If, therefore, there are no visible signs of a scar upon the body, post mortem, a cautious opinion should be given as to whether no cicatrix existed in life. This is particularly so where the process of putrefaction has already commenced.

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[1] Legal Medicine. [2] Ibid.

If, on examining a limb or other part of the body where at some former ne a wound is alleged to have been inflicted, no cicatrix is found, the edical examiner should be justified in assuming that the allegation is not nsistent with the facts presented, and that no wound was ever inflicted.

Can a cicatrix, when once formed, be removed either by time or by arti-icial means? In wounds of a slight nature, those which involve merely the idermis, or in those cases of cuts or punctures of the cutis without loss of bstance, the lapse of time may cause their disappearance. They are not, owever, invariably obliterated. Taylor states that if any scars were readily bliterated, it would be those which result from sharp cutting instruments,— other words, those which are regular and even, such as follow incised ounds. From his own observation, however, he has known these cicatrices remain unchanged for periods varying from twenty to twenty-five years. Ie further states that the scars of contused and lacerated wounds often indicate e *form of the weapon* that produced the injuries. It is well to remember at the cicatrix of a stab often simulates that produced by a bullet discharged om a pistol at a distance. Both possess round and irregular edges, and ave a puckered appearance, unless the stab was the result of a broad-bladed nife. Ogston states that he has known the scars of syphilitic chancres to isappear within six weeks; but, as Tidy remarks, such cases are very rarely resented. The latter authority states that the intensity of a scar varies considerably with the person's state of health. Thus, in the case of an old cicatrix resulting from a boil, which under ordinary circumstances was scarcely discernible, the existence of dyspepsia in the patient caused it to become exceedingly well marked.

The obliteration of cicatrices which result from skin-diseases, or those of wounds involving a loss of substance, is scarcely a possibility, although certain inherent changes in the scar itself may cause it to be less distinct.

Scars the Result of Disease.—Questions relative to the cause of cicatrices may arise. Thus, it may be stated that a scar was produced by a wound, when, in reality, it resulted from loss of substance through disease.

Scrofulous ulcers are followed by cicatrices. They are deeply furrowed and irregular. If recent, they possess a flat appearance and a bluish-red color. Nevertheless, they also appear somewhat raised above the surrounding skin. The scar of a syphilitic abscess is very deep, as is also that producedby small-pox. They are, however, situated below the surface of the skin. The cicatrices of different other ulcers cannot be well described unless particular attention is paid to their situation,—*i.e.*, as to whether they involve loose or dense tissue.

To decide the nature of the cause which produces the cicatrix, the medical examiner must note the general characters and locality of the scar. For example, a syphilitic abscess would be suggested by a cicatrix in the inguinal region, while a scar in the neck might suggest a strumous abscess. The bend of the elbow might show the cicatrix produced by venesection, and so on.

Characters of Cicatrices.—As a result of the contraction of the skin during the healing of a wound, a scar appears smaller than the original wound. This is well shown in the case of stab-wounds. And here it is important for the examiner to observe that it is extremely difficult to form an opinion as to the exact size of the weapon. (*Vide* also Gunshot Wounds.)

CHAPTER XXVI.

WOUNDS REGIONALLY CONSIDERED.

Wounds of the Head—Of the Face—Of the Neck—Of the Spine and Cord—Of the Thorax and Contents—Wounds and Ruptures of the Diaphragm—Wounds of the Abdominal Walls and Viscera—Wounds of the Genitals—Wounds of the Extremities.

FOLLOWING the character and evidences of wounds in general, it will be proper now to consider injuries as they affect the various parts of the body, inasmuch as they present individual peculiarities of interest to the medical jurist. The dangerous character of wounds and the influence they exert in causing death must be carefully studied, since they are of great medico-legal importance.

Wounds of the Head.—*Incised wounds* of the scalp rarely occasion dangerous results, unless they are very extensive. With proper management these wounds heal rapidly, owing to the vascularity of the parts. On account of the non-contractile power of the blood-vessels in this situation, hemorrhage from incised wounds may be rather copious, but it is rare for any serious effects to follow. Erysipelas often complicates these wounds, a fact probably due to the imperfect cleanliness of the parts. This complication serves to mark the difference between these injuries and similar ones located elsewhere. Another source of danger in scalp-wounds is the development of diffuse cellulitis, which may occur as well as the affection referred to above. Scalp-abscess or diffuse cellulitis of the scalp follows the infection of the wound, which apparently nurtures germs due to imperfect cleansing of the parts from foreign matter, injudicious handling, or from other sources. Notwithstanding the marked or severe constitutional disturbances which may be present, the prognosis is generally good. The erysipelas of slight injuries of the head gives suspicion of a constitutional predisposition. Neither of these secondary effects is to be regarded as an unusual result of a severe injury to the scalp; but if death follow either one of them, especially if they be the consequence of a slight wound, the constitutionally predisposed condition of the injured person may be considered as a mitigatory circumstance. Maltreatment may cause fatal effects to ensue in wounds which otherwise may not be regarded as other than trivial. Here the question may arise as

o whether a circumstance of this nature would affect the responsibility of he assailant. (*Vide* pp. 275, 280.) The dangerous character of wounds of the head is proportionate as they involve the brain or not; and it is of importance for the medical examiner, when dealing with such injuries, to remember that the external appearances of a wound are often very misleading, since the internal injuries may be obscured. Thus, frequently, the sequelæ of the slightest injuries may be followed by death.

Contusions and *contused wounds* of the head generally result from blows or falls. They are almost always produced by another person, or are accidental. A contused wound, accompanied by considerable laceration of the parts, is invariably dangerous, in consequence of its susceptibility to inflammation and infection. Severe wounds of this description usually complicate the brain. It must not be forgotten that the skull may be fractured without any apparent wound of the scalp, and, further, that death may follow an effusion of blood upon the brain, caused by the infliction of a blow, without any external appearance of either a wound or fracture.

One of the results of contusions of this region is the swelling beneath the pericranium due to the extravasation of blood. Such hæmatomata present, on palpation, a soft, yielding centre, the fluid blood, and a hard, distinctly outlined edge, the fat and coagulum. To differentiate a contusion from a depressed fracture, notice must be taken of the hard margins about the central depressed area of the contusion and the movable condition of the blood-clot on the surface of the skull, while in fracture the examining finger does not first encounter a ridge, as is the case in contusions, but passes at once from the surface of the skull into a depression. Moreover, the edge of a depressed fracture is more irregular, less evenly circular, and sharper.

As has been mentioned in another place (*ante*, p. 265), contusions and contused wounds may sometimes possess the marks of the weapon, showing that they were produced by another person. The origin of the injury may often be indicated by its situation; also, the position may show whether it is accidental or was inflicted by another. Thus, an injury to the vertex would not be accidentally inflicted unless the injured person was precipitated from a considerable height. The complications which may follow incised wounds are liable to occur in connection with contusions or contused wounds, and more so on account of the tendency which these injuries have toward the inflammatory process.

Punctured wounds, even when slight, may end in death in consequence of inflammation and suppuration. *Lacerated wounds* of the scalp heal remarkably well, although, if the parts involved by the laceration are extensive, dangerous symptoms may ensue. On the other hand, recovery may take place even where most of the integuments have been torn from the bone.

Fracture of the Skull.—This is the result of a sudden concentrated force, as the blow of a hammer, or a fall upon a hard body, such as a stone. Fractures of the head are classified as those of the *vault* and those of the *base*. Partial fractures involve the inner or outer table of the skull,

while those which are termed *complete* involve the entire thickness of the skull. To the latter class belong what are called fissured, stellate, comminuted, depressed, and punctured fractures. Fractures of either the vault or base may be simple or compound.

Fractures are serious in proportion as they affect the brain, although a properly treated fracture furnishes a good prognosis without regard to any lesion of the brain. Simple fractures of the vault of the skull, without displacement, can only be inferred from the accompanying symptoms. If there is displacement, it can often be detected by carefully examining the surface. Depression generally exists, and the abrupt margins of the bone may be appreciable to touch on palpation. Signs of compression are usually present. When the fracture is compound, its margins may be felt by the finger. Hemorrhage is frequently copious, and there may be an escape of cerebro-spinal fluid from the wound. Inspection and palpation through the wound will generally clear up the case. The vault of the skull may also be broken opposite to the point originally struck (*contre-coup*), although it may happen that an inspection of the parts will detect a fissure extending from the point first injured to the opposite side of the skull.

Fractures of the base of the skull present a less favorable prognosis, since they may become rapidly fatal on account of the injury inflicted upon the vital centres, or from the effusion of blood into the parts at the base of the brain. Death may also follow the secondary results, such as inflammation or meningitis, irrespective of proper medical treatment. Fractures are due either to direct or indirect force. The latter may be due to falls upon the buttocks or feet, which force the spine against the condyles of the occipital bones; or the fracture may be occasioned by what is termed a counter-stroke, as when it results from an injury to the vault, the violence of which is transmitted to the base, which breaks. Falls upon the vault of the cranium force the condyles of the occipital bone against the top of the vertebral column; and if the head is in a state of flexion, the sudden force is transmitted backward, expending itself upon the posterior cerebral fossa. But if there be extension of the head, the force is carried forward, being exerted on the anterior or middle fossa of the skull. In the conduction and amplification of vibrations the force is very great but also diffused. If transmitted to the frontal region, fracture of the anterior cerebral fossa generally occurs. If the force be applied to the temporo-parietal region, the middle cerebral fossa is broken; and if the force be transmitted to the occipital region, fracture of the posterior cerebral fossa follows.

Fracture of the *anterior cerebral fossa* is followed by a copious and continuous hemorrhage from the nose. There is also subconjunctival effusion with palpebral ecchymosis, generally involving the lower eyelid, and an escape of cerebro-spinal fluid from the nose. There is also paralysis of the olfactory, optic, or oculo-motor nerves, due to the concussion or compression. It is well to remember in these fractures that the cerebro-spinal fluid and blood may find their way into the pharynx. Fracture of the *middle cerebral*

ssa is detected by the free and continued hemorrhage from the ear, and the w of cerebro-spinal fluid, which increases in quantity on pressure of the gular veins. After a few days there may be paralysis of the auditory and cial nerves. Escape of cerebro-spinal fluid and blood into the pharynx y the Eustachian tube follows, if the membrana tympani be intact. In actures of the *posterior cerebral fossa* there may be depression or comminution, copious pharyngeal bleeding, and ecchymosis of the regions at he side of the neck. If the latter be not involved, late discoloration may rove of value as a symptom of fracture of the middle or posterior fossa.

Fractures of the head, often by their shape and occasionally by their size, show the shape and more rarely the size of the weapon producing them.

Concussion.—By this is meant the condition of nervous shock or jarring of the brain induced by more or less violent blows or falls on the head. It is generally associated with contusion of the nervous masses and with fracture of the skull. The *contusion* is either circumscribed or diffused, and may cause bleeding *en masse*, or a diffuse miliary extravasation. The ffects of the contusion may be either at the point injured or at the opposite ortion of the brain; it is generally associated with laceration and more r less effusion of blood. Concussion may be present without the brain eing lacerated, and fatal results have occurred without any indication of rain-injury. It may sometimes be produced by a violent fall upon the feet, d the base of the skull may be broken by the sudden impact against the p of the vertebral column. When concussion is associated with displaceent of the fractured parts, as it occasionally is, or with hemorrhage within e cranium, its symptoms are obscured by those of compression. Hence it of importance to remember that symptoms of an injury to the brain may ccur which belong neither to concussion nor compression.

The *symptoms* of concussion vary in intensity from a momentary loss of onsciousness, which leaves the patient temporarily confused or giddy, with r without falling, to a prolonged unconsciousness, with a feeble, scarcely erceptible pulse, shallow breathing, pale, cold surface, subnormal temperaure, muscular relaxation, and variable pupils, depending on the situation and character of the injury. The occurrence of vomiting in a severe form of concussion is rather a favorable than an unfavorable sign, as the sufferer usually rallies after it. If there be screaming, restlessness, and local spasm, suspicion of laceration may be entertained. After a time the stage of cerebral irritation may ensue, when it is difficult to arouse the patient from his prolonged stupor. Urine and fæces may be passed involuntarily; the pulse is small and feeble, the breathing easy, and the pupils contracted. The third stage is characterized by inflammation, abscess, and softening; and this may be succeeded, later on, by a tendency to disease of the brain. Shock is always associated with concussion and contusion.

In some cases the recipient of a blow upon the head falls and dies instantly from concussion, and the autopsy reveals nothing, perhaps, but a

trifling contused wound of the head, to account for the strange result. The *prognosis* is always bad where the stupor is prolonged.

Concussion may sometimes be mistaken for *alcoholic intoxication*, and the medical witness may be asked to state the differences that exist between the two. The distinction between the state of concussion and that of alcoholism may occasionally be established by the history of the case. Nevertheless, this is not always easy to do, and the decision between the two affections must be based upon other circumstances. The odor of alcohol in the breath is no proof of intoxication, for a person may have received a concussion after having drank liquor; or, again, the latter may have been administered by a by-stander after the accident as a stimulant to the heart. If, on the other hand, there be no alcoholic odor about the breath, the presumption is in favor of the accident. In slight forms of concussion, where the person walks as one under the influence of an intoxicant, talks unintelligibly, wanders about, and performs acts in an aimless manner, the condition may easily be confounded, by a layman, with alcoholism. Under such circumstances it is well to await further developments as to the real nature of the case. In case a person dies in an extreme state of alcoholism, there may be nothing to show whether death be due to the intoxication or to concussion. As Balch[1] says, there may be contusions on the cranium in both instances, liquor may be discovered in the stomach in both, the brain is equally congested, and the other post-mortem signs are alike in both cases. All that the medical examiner can do in such cases is to note the individual circumstances. If there be any doubt as to the real nature of the case, the physician should so state it to the proper authorities. Taylor[2] states that "there is nothing in the state of the brain in a dead body which will enable a practitioner to distinguish whether concussion or intoxication has been the cause of the symptoms."

Extravasation or Effusion of Blood from a Blow.—Intracranial extravasations of blood may occur in the following parts: (1) between the dura mater and the skull; (2) in the cavity of the arachnoid; (3) on the brain-surface; (4) in the substance of the brain; and (5) in the ventricles. When the extravasation is due to concussion, the sources of the blood between the dura and skull are the small vessels extending from the dura to the bone, the middle meningeal artery, which is the usual source of copious hemorrhage, and the venous sinuses. These latter are rarely a source of effusion.

Effusion of blood between the dura and the skull is manifested by the signs of compression appearing after a period of immunity. Almost immediately after an injury to the head has been inflicted, concussion and shock supervene. There is then a stage of reaction, the patient apparently recovering; but this condition is soon succeeded by the true signs of compression. There is spasm, with paralysis of the face, arm, or one side of the body, accompanied by a decline of the body-heat. This is succeeded by coma and a widely

[1] Hamilton's System of Legal Medicine. [2] Medical Jurisprudence.

dilated state of the pupil of the affected side. If the hemorrhage be in the cavity of the arachnoid, there may or may not be signs of compression, although there is nothing diagnostic. After a time the patient may become irritable, and suffer with headache, or convulsions may appear. Cerebral laceration generally accounts for blood in the pia mater, which is considerably diffused. The symptoms here are those of the injury or of apoplexy.

When the extravasation of blood is due to violence, it may or may not be associated with fracture, and it may take place without any extracranial lesions. The most fatal extravasations are encountered in those cases associated with a fracture of the base of the skull. Laceration of the brain and effusion of blood to some extent at the base may coexist while the patient still lives. Taylor refers to the case of a woman who survived for twelve days severe injuries to the head supposed to have been inflicted by her husband. She remained unconscious during this entire period. Some of the extracranial lesions had passed through the usual color-changes, while others had almost disappeared. The blow was probably received upon the vertex. The autopsy revealed a laceration of the brain by counter-stroke and a coagulated mass of blood in the lacerated portion. This clot extended into the ventricles after having passed over the base of the brain.

A person with a serious injury to the head from violence may recover from the first effects, and be apparently regaining his previous health, when he suddenly suffers a relapse, becomes much worse, and dies. Here the effusion of blood takes place slowly, a fact proved by the autopsy, which reveals a partially organized clot of different tints.

Sometimes the question as to the cause of the effusion arises, *whether it be due to disease or to violence.* The importance of this medico-legal question cannot be slighted, for in case of homicide the defence may claim that the effusion of blood was the probable cause of death. If the extravasation be between the dura mater and the skull, or if it be beneath the dura or associated with a superficial laceration of the brain, the effusion is due to violence. When the hemorrhage is due to traumatism, it is found most frequently under the point injured, although it may be directly opposite to this. This is well illustrated in the above-mentioned case, where the injury was by counter-stroke, and was found at the base of the brain together with the extravasated blood.

Effusions of blood due to disease are commonly *within* the brain-substance, although they sometimes occur *without*, as a result of great excitement, especially if accompanied by alcoholism, or from over-exertion of the muscular powers. These hemorrhages seldom take place before forty years of age, except in alcoholic subjects. On examination, the blood-vessels will be found diseased, and the substance of the brain may be in a state of softening.

In cases where there is a history of injury coexisting with disease of the cerebral vessels, or of the brain-substance itself, the difficulty of ascertaining the exact cause of the spontaneous effusion of blood is greatly increased.

Woolsey says, "Where the injury was slight in the case of alcoholics or aged people, the medical witness should be especially careful in stating that a cerebral hemorrhage was due to the injury. Then, too, in the act of falling, from the occurrence of a cerebral hemorrhage due to disease, the head may be injured and show marks of violence. It should be borne in mind that an injury to the head may be inflicted when disease of the brain, vessels, or membranes already exists. In such a case a slight blow might cause extensive hemorrhage; but as that which accelerates causes, death, even though it might sooner or later have occurred in the same manner without injury, is due to the injury inflicted."

A fatal effusion of blood in or out of the brain from great excitement in a quarrel is of rare occurrence, unless the blood-vessels be diseased or the person aged or alcoholic. It is seldom seen in the young and healthy. Where doubt exists as to the cause of the effusion, the medical witness should state which was the more probable cause, in his judgment. The description of the following case is taken from Balch's contribution to Hamilton's "System of Legal Medicine," p. 299: "In 1880 two policemen in Albany were summoned to arrest a man who was creating a breach of the peace. The fellow was drunk, or had been, and was ugly, as the stupefying effects of the liquor were passing off. His age was a little over thirty years. He refused to be quiet when the officers appeared, and they started to take him to the station-house, about three-quarters of a mile distant. The man fought, and the patience of the officers becoming exhausted, one of them used his club, hitting the prisoner over the right temple. He was only hit once or twice, the skin was not cut, and no fracture was caused. The prisoner continued his struggles all the way to the station-house, but was not struck again. After his name was put upon the blotter, he fought the officers to the cells, and until he was pushed into one and the door locked. Then he continued to swear and abuse them as long as they were within hearing. The arrest was late in the afternoon. The watchman saw and spoke to the prisoner in the evening, getting curses for a reply. He saw him again before midnight, when he stated that the man was asleep and snoring. In the morning the prisoner was dead. An autopsy was held by the coroner's physician, and he stated that he found a contusion with a clot under the muscle; no fracture of the skull, no break of the skin. On opening the skull, nothing was found external to the brain; but on section, a clot, evidently from the branch of the right anterior cerebral, was found buried in the right lobe. The rest of the autopsy did not show very much, according to the doctor's report, and he gave as a cause of death the hemorrhage in the brain. This led to the arrest of the two officers and the presentment of the case to the grand jury. The defence had the body exhumed and further examination made. The statements of the coroner's physician were substantiated as far as the contusion and there being no fracture of the skull, but from that on I differed from the opinion that the man was healthy. Both kidneys and liver were fatty. Specimens of the aorta, vertebral, basilar, and cerebral arteries

en and put under the microscope. All proved the presence of fatty ıtion. The condition of the contused part was carefully examined. derable decomposition had taken place, it being in the summer, the from the contusion was not so conclusive as it was on the first tion, so questions were asked the doctor who had held the first au- ncerning this and other points. Upon the statements made by him n the microscopical appearances, I gave the opinion that the rupture to disease, and was not caused by the blow."

medical examiner, when engaged in the investigation of cases of this on, should always, if possible, ascertain whether the violence itself sufficiently great to account for the extravasation of blood without ence of disease, etc. The question as to the *date of an effusion of* or upon the brain may arise,—*i.e.*, whether it was produced by a inflicted blow or had existed previously. Recent extravasations are of a red color, which, after some days, changes to a brown or e, and finally to an ochre, which may be seen from twelve to twenty- after the hemorrhage. The coagula, with age, become of firmer con- and are somewhat laminated. The expressed lymph may be found he clots or between the laminæ. It is impossible to tell the exact an effusion of blood, but the color and consistence may indicate it be old or recent.[1]

following table, after Agnew, shows the distinctive symptoms of on and compression, although it must be remembered that in many s impossible to distinguish between them, since the symptoms of one to those of the other, each being in this way completely masked by r.

Concussion.	Compression.
emi-conscious; special senses , not abolished.	Absolutely unconscious, paralyzed, and with abolition of special senses.
movement retained.	
n quiet and feeble.	Respiration full and noisy.
le, frequent, and intermittent.	Pulse full, slow, and laboring.
d vomiting.	Neither nausea nor vomiting.
erally contracted.	Pupils generally dilated; often unequal.
l temperature.	Temperature about normal.

nds of the Brain.—These are not always fatal, their results varying g to the part of the organ involved. Occasionally trifling wounds ife immediately, while severe injuries in another part of the brain Slight inconvenience only often follows severe wounds to the frontal

writer has seen many sand-bag and slung-shot injuries to the head, some showed abrasions, while others exhibited no external indications of an in- actures are usually produced by the fall after the infliction of the blow.

If the first effects of a wound of the brain pass off and the patient lives, there is still the danger of inflammation, which may develop slowly, even as late as ten weeks after the injury was received. It may be very protracted. It is of importance to recollect that wounds of the brain are not necessarily followed by unconsciousness or by paralysis. Many cases are recorded of brain-injury in which, after the infliction of the wound, the person was able to perform many acts. Thus, many will recall the report of the case of the man Gage, through whose head passed a tamping rod three feet seven inches in length, an inch and a quarter in diameter, and weighing thirteen and a quarter pounds. The wound commenced just anterior to the ramus of the inferior maxilla of the left side, assuming an upward and backward direction toward the median line, passing through the left anterior lobe of the cerebrum, and making its exit at the junction of the coronal and sagittal sutures. The rod produced a laceration of the longitudinal sinus, fractured the frontal and parietal bones, broke up a large portion of the brain, and forced the left eyeball from its socket by almost one-half its diameter. The patient lived many months after the injury, and followed the occupation of a stage-driver. He was in the enjoyment of good health, with no impairment whatever of his mental faculties. Watson is quoted by Taylor as citing the case of a quarrel between a man and his son. The latter threw a poker at his father with such force that the head of the weapon became fast in his forehead, and was with difficulty removed. The father requested the bystanders to remove it, and he afterwards walked to the hospital. Death occurred from inflammation of the brain. Woolsey states that the acts indicative of volition and locomotion "may be raised in relation to an attempted *alibi* of the accused, who may have been proved to be in the presence of the victim a moment before death. If after this moment the victim has moved from the spot or performed certain acts before death, the attempted *alibi* may depend upon the answer to the question as to whether the given acts of the victim were compatible with the fatal character of the wound. An *alibi* can aid in the acquittal of the accused only when the nature of the injury was such that death would be supposed to be immediate or nearly so. Great care should be taken on the part of the medical witness in answering this question, for, after very grave wounds proving speedily fatal, the victim sometimes can do certain acts requiring more or less prolonged effort, as shown by numerous examples."

Wounds of the Face.—These are not usually considered dangerous unless they involve the orbit. Thus, the brain may be injured by a penetrating weapon, and death result. Otherwise, facial wounds heal by first intention, on account of the great blood-supply of the parts.

When these wounds are of any great extent they become important, medico-legally, on account of the possibility of deformity of the parts involved; thus, they may produce great disfigurement, which may result in a civil suit. If the wound be made over the orbit, involvement of the supraorbital nerve may occasion traumatic neuralgia or amaurosis due to paralysis

f the superior eyelid. Injuries to the orbit, such as those made by penetrating instruments (*supra*), while not always immediately fatal, may give ise to an inflammation of the orbital contents, which subsequently extends o the brain, and in this way causes death. Therefore all wounds of the rbit are serious, while, if deep, they are absolutely dangerous.

Injuries to the nose may fracture the ethmoid bone, and later on involve the brain, producing a fatal meningitis. Deformity may follow a fractured nose and arch, but, if the latter remain intact, deformity may not result. Wounds which penetrate the cavities of the nose may become serious, for the inflammation and suppuration that follow may involve the upper passage, extending to the ethmoidal and sphenoidal cells, and thus reach the brain. The wounding of Steno's duct is of a more serious nature than other incised or lacerated facial wounds, from the fact that a fistula may result, thus complicating the injury.

Among the questions that may be asked the medical witness are, Is it possible for the wound to be followed by deformity? or, Could the wound heal without being attended by deformity? or, Is it possible for the deformity, if it exist, to have been caused by other means than the wound?

Wounds of the Neck.—These are usually very dangerous, on account of the large vessels and nerves in this region. They are commonly incised, and most often suicidal. Their danger lies in the sudden and profuse hemorrhage that attends them. Self-inflicted throat-wounds extend obliquely from left to right, and from above downward. They are most frequently found in the laryngeal region, especially over or through the thyro-hyoid membrane. Wounds superior to the hyoid bone may involve the tongue, the lingual artery, the facial artery, and the hypoglossal nerve. They gape extensively, and often there is an escape of saliva and food. Those passing through the thyro-hyoid membrane open the pharynx and may divide the epiglottis, the superior thyroid artery, the lingual artery, and the superior laryngeal nerves. Those penetrating the cartilages may involve the vocal cords and the recurrent laryngeal nerves. The hemorrhage in this region is usually moderate. Wounds below the cartilages may divide the superior or inferior thyroid arteries, the thyroid and anterior jugular veins, the trachea, and perhaps the œsophagus. The division of the larynx and trachea is not necessarily dangerous, the principal danger being the suffocation due to the backward flow of blood. Section of the œsophagus, on the other hand, is almost always fatal, on account of the division of the great vessels. Aphonia may follow division of the recurrent laryngeal nerves, while death may be the result of the involvement of the sympathetic and pneumogastric nerves. The carotid arteries are rarely injured in suicidal wounds, as the force is expended before they are reached. In homicidal cases the great vessels of the neck are likely to be involved in the wound, as greater force is exerted. Here the incision may be from right to left, or *vice versa*, and if the fact was known that the victim was right-handed, a case of murder would naturally be suspected. With regard to stab-wounds, "If the blow misses its mark

by the assailed turning, or from whatever cause, a slight wound may result," says Balch, "the knife only passing through muscular tissue without severing any vessels, trachea, or œsophagus. These wounds are almost always homicidal, and, from their position on right or left side, struck probably from behind or in front. The evidence of the wound will lead the medical examiner to the conclusion of the assailant's position. They are dangerous wounds, and, if dividing the large blood-vessels, almost immediately fatal. When the weapon is driven with sufficient force, and by chance takes the proper direction, the spinal cord may be severed, the blade passing between two vertebræ. In such case the assailed drops at once, for, if not instantly killed, he is instantly paralyzed below the section." [1]

The *immediate dangers* of penetrating wounds of the neck are arterial or venous hemorrhage, suffocation, and the entrance of air into the veins. The suffocation may be due to the plugging of the air-passages with either the tongue, blood-clot, the epiglottis, or the severed cartilages. The *secondary dangers* are œdema of the larynx, emphysema, bronchitis, broncho-pneumonia, cellulitis, cicatricial contraction, and stricture.

Insensibility, or even death, may follow severe *contusions of the neck.* These latter may produce fracture of the larynx, laryngeal hemorrhage, and asphyxia. These injuries are most frequently the result of accident, although they may be inflicted by another. *Garroting* produces injuries to the larynx or trachea similar to those caused by a contusing blow.

Wounds and Injuries of the Spine and Cord.—Wounds of the vertebral column, including the cord, are somewhat similar to those of the brain. They may be caused by concussion, compression, or violence. Paralysis commonly follows concussion. Secondary effects, such as inflammation and softening, often succeed blows upon the spinal column, even when unattended by fracture or dislocation. The danger of wounds or injuries to the spinal column is proportionate to the degree in which the cord is involved. Death may take place instantly from wounds above the region of the phrenic nerve, since respiration is immediately arrested, and, no matter where the wound is located, if the cord be involved, the functions of the parts below are suspended. Slight injuries have occasioned inflammation of the organ and death.

Fractures of the spine are nearly always complicated by dislocation, with the result that there are generally displacement and compression. Their degree of fatality depends on the seat of the injury. Death rapidly follows when it is situated high up in the vertebral column. If the seat of compression be in the *dorso-lumbar region*, paraplegia, retention and overflow of urine, and incontinence of fæces occur; if it be in the *dorsal region* (second to eleventh dorsal vertebra), we have paralysis of the abdominal muscles and the muscular coat of the intestines. The movements of expiration are greatly embarrassed from the involvement of the serratus posticus inferior, the

[1] Hamilton's System of Legal Medicine.

quadratus lumborum, the sacro-lumbalis, and the longissimus dorsi muscles. If the *cervical region* be the seat of the compression,—*i.e.*, if it be above the fifth and sixth cervical vertebræ,—then paralysis of the arms takes place, together with an increased embarrassment of the respiratory function due to the involvement of the long thoracic nerves (fifth and sixth). Where the compression is above the third and fourth vertebræ, a fatal result occurs immediately or very rapidly from paralysis of the muscles of respiration. Fracture of the atlas or axis is not always instantly fatal, since the space of the canal is sufficiently large to prevent any encroachment upon the cord.

The *symptoms* of these fractures are crepitus, mobility, and deformity. Immediate paralysis, as stated above, takes place in the parts situated below the injury, together with the loss of power to control the bladder and rectum. The temperature of the parts paralyzed is usually increased. Lutaud[1] states that secondary paralysis may sometimes follow fractures of the spine after healing of the fracture. In connection with fracture-dislocation, it is well to recollect that the patient may survive a considerable length of time after the infliction of the injury. The *cause* of these injuries is direct or indirect violence, and the parts of the vertebra usually involved in the break are the spinous processes, laminæ, and the body. Spontaneous dislocation of the second cervical vertebra, due to fracture of the odontoid process through disease, has caused instant death.

Fracture of the spinal column is usually attended by *concussion*, due to the profound shock of the violence inflicted. Death may speedily follow, and this without any external or internal mark of injury. (*Vide* Railway Injuries.)

The region of the spinal column is rarely the seat of incised or punctured wounds, and such wounds and injuries as do occur are generally accidental, although they may be homicidal or even suicidal. *Pithing*, or the puncturing of the medulla oblongata by means of a small needle-like instrument, is often practised, especially in infanticide. It may be accomplished without leaving scarcely any trace. (*Vide* also Gunshot Wounds.)

Wounds of the Thorax and Contents.—Non-penetrating wounds of this region are those which do not involve the costal pleura. These wounds are rarely dangerous, but they may become so, especially if carelessly examined, when they may be converted into penetrating wounds. Furthermore, they may involve such important structures as the brachial plexus of nerves, the intercostal, internal mammary, acromio-thoracic, long thoracic, or axillary arteries. The prognosis is always favorable in non-penetrating wounds, unless they be aggravated by incidental circumstances. Incised wounds are rarely observed, but those of a contused nature are common. This latter class of injury, together with contusions, is dangerous in proportion to the degree of violence employed. They may be homicidal, or at least made by another. Such injuries are usually accompanied by fracture of the

[1] Manuel de Médecine légale, 1892.

ribs; of the sternum; rupture of the thoracic organs, including the dia-phragm; copious bleeding; or, secondarily, by inflammation of the thoracic viscera, with or without suppuration.

Fractures of the ribs are caused by direct or indirect violence, or by muscular action. They are most often the result of blows, falls, or the counter-pressure of opposing forces, such as when the wheel of a wagon runs over the chest of a person. They are considered to be very dangerous, as the bones may be splintered and wound such important organs as the lungs, heart, etc., or inflammation of the pleura or lungs may follow. The ribs most commonly fractured are the fifth to the tenth, as the upper ones have better protection and require the application of more force to affect their substance. The greater elasticity of the lower ribs affords them a certain se-curity. The common seat of the break is just anterior to the angle of the bone. The diagnosis is generally easy. Crepitus and mobility may be elicited by merely pressing the finger along the skin over the line of the rib supposed to be broken. The patient may experience a painful stitch at the site of the injury, and the respiratory movements are to a certain extent restricted thereby. If displacement be present, it occurs internally from direct force and externally from indirect violence. The prognosis of fracture of the upper ribs is not so good as in those of the lower, because, as heretofore mentioned a greater degree of force is necessary to cause the break.

Fracture of the sternum is not attended with danger if it be simple, without any displacement of bone. When, however, the concussion produces depression as well as fracture, and the organs behind are involved, it is extremely dangerous, if not fatal. The cause of these fractures is either direct or indirect. The deformity is easily appreciable to the touch. Crepitus and mobility may be detected by causing the patient to take a deep inspiration, or by extending the body. This injury is usually a separation of the bone at its cartilaginous junction. Here the crepitus would be smooth.

Penetrating wounds of the chest may involve the pleura and lung, the pericardium and heart, or the great vessels. In *wounds of the lungs* the immediate danger is the hemorrhage. These injuries are characterized by shock, difficulty in breathing, cough, pain, abdominal breathing, emphysema pneumothorax, and hæmothorax. The blood escapes through the wound and from the mouth, being coughed up. It is bright red and frothy, the latter sometimes appearing also at the mouth of the wound. The blood may be stained with mucus, and as it escapes through the wound may be accompanied by a hissing sound (*tromatopnœa*). Woolsey says that the bleeding from the external wound may be slight, especially if it is oblique and acts as a valve.[1] In case the pleura alone is involved by the wound, there will be no expectoration of blood and no bloody froth from the external wound. The hemorrhage from the mouth must not be diagnosed as pulmonary until an inspection of the injured person has excluded stab-wounds of the ne

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

knitting-needles, narrow-bladed shears, etc. The writer has seen such a
e recently.

The complications of these wounds, some of which have already been ned, are external hemorrhage, hæmothorax, emphysema, pneumothorax, urisy, pneumonia, and prolapse of the lung. Hæmothorax is hemorge into the pleural sac. Its main cause is a wound to the lung or intertal artery by a fractured rib. The symptoms are those of internal eding, accompanied by a bulging of the intercostal spaces, dyspnœa, ness on percussion, and absence of respiratory sounds. Inflammatory ision may follow a few days later. By pneumothorax is meant an injury the lung and pleura by a fractured rib, etc. Here there are collapse of the an, increased dyspnœa, amphoric respiration, great percussion resonance, tallic tinkling, and bulging of the intercostal spaces. Emphysema is duced by a wound to the lung and pleura. It may, however, follow ry to the lungs alone. It is characterized by a diffused, colorless, elastic, fy swelling, crackling on pressure. Hernia of the lung may result from giving way of a cicatrix, the accompaniment of superficial wounds. ere is usually a soft circumscribed tumor, which is resonant on percusn, furnishing a loud respiratory murmur, and crepitating on pressure. ncussion of the lung is a condition following traumatism, and characterd by difficulty in breathing, feeble respiratory murmur, and slight dulness percussion.

The prognosis in wounds of the lungs is always doubtful. Patients often over from the primary effects of the injury to die from such secondary ects as inflammation, recurring hemorrhage, or a relaxation of the regin. The death may also be the result of the patient's own imprudence, d it is well for the physician to make note of such matters, as they may en be regarded by the defence as mitigatory circumstances.

Wounds of the heart nearly always end fatally and rapidly, if the cavities the organ be involved. Gunshot injuries to the heart are not always imediately fatal. In the Fitzpatrick-Smith homicide case, which came under e writer's notice, the man Fitzpatrick lived six days after a gunshot wound the left ventricle. The bullet tore one and a half inches of flesh off the art, and then lodged in the back, between the ninth and tenth ribs.

As with the lungs, blows or severe contusions may cause rupture of the art. Stab-wounds are usually instantly fatal on account of the shock and e hemorrhage; but, if the cavities are not involved, death may not take ace until several days after the infliction of the wound, and may be due to flammation. Fatal wounds of the heart may be made by small pointed struments, like needles. These wounds may show but little hemorrhage. at these punctures are not necessarily fatal, Woolsey[1] quotes Senn as ying, "The heart can be punctured with a perfectly aseptic medium-sized pirator needle without any great immediate or remote danger."

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

The part of the heart most often wounded is the right side, particularly the ventricle, no doubt on account of its more exposed position anteriorly. The rapidity with which death follows these wounds depends to a certain extent upon the situation and extent of the injury. Woolsey cites Lutaud as stating that of twenty-four cases of injury to the right ventricle, two only resulted in death within forty-eight hours, and of twelve cases of injury to the left ventricle, three were not instantly fatal. Wounds of the auricles end fatally and rapidly, especially where the cavity is largely involved. They produce fatal results most speedily next to wounds of the right ventricle.

In wounds of the heart fatal results are produced by two causes,—hemorrhage and compression of the organ by the blood in the pericardium, preventing the cardiac movements. In these cases death may be sudden or it may be prolonged. This latter fact, says Woolsey, "is of little importance as a rule in surgery, for the patients generally die sooner or later; but it is of importance in medical jurisprudence, for upon it may hang the solution of questions of murder, suicide, or justifiable homicide. It also accounts for the fact that the injured person can exercise voluntary power after the injury." Thus, in a case he quotes from Watson, "a man ran eighteen yards and died six hours after a stab-wound of the right ventricle." [1]

Rupture of the heart, as stated before, may be the result of a violent blow, or it may follow severe contusions upon the thorax. Intense excitement or emotion sometimes causes the same result if the organ be diseased, as in fatty degeneration. In this connection the question may arise as to whether the rupture was occasioned by disease or violence. The counterpressure of opposing forces, as of a vehicle or heavy weight on the chest, may cause rupture of the organ. Here there may be no external injury apparent; and, although these cases are almost always immediately fatal, there are some exceptions. Balch [2] cites the following interesting case: "I remember a case which was brought into the yard of the old New York Hospital in 1869, when it was on Broadway. I was serving as a substitute on the surgical division, and, happening to be alone, was called to see a patient just brought in by the police. Going down to the yard, I found a man lying in a push-cart, insensible, very pale, and evidently suffering from shock. Asking the accident, the officer stated that the man had been pushing his cart along Broadway, when he was knocked down by an omnibus and run over. The mark of the wheel was plainly to be seen on the patient's clothes, and the mark extended from the right hip to the left shoulder, passing directly over the heart. No fracture could be found. I went to report the case to the superintendent and get the order for his admission. When I left, the man was still insensible. When I returned, after an absence of about six to ten minutes, I heard a shout of laughter in the yard, and there

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

[2] Hamilton's System of Legal Medicine.

was the man on his feet and using language more forcible than polite at being detained until 'some fool doctor' would let him go, and he not hurt. He went, pushing his cart before him, nor did he thank the policeman who had pulled him out from his dangerous position, or the 'fool doctor' who tried to make a patient of him."

Wounds of Arteries and Veins.—Serious and even fatal results may follow injuries to the intercostal or internal mammary vessels, or to the vena azygos veins. Wounds of large trunks are almost invariably speedily fatal. These injuries are either penetrating or non-penetrating. In the latter class the outer coat or coats of the vessel are involved, and the artery may subsequently ulcerate and, yielding to the pressure of the circulation, produce extravasation, or it may cicatrize and then gradually give way, forming a true circumscribed traumatic aneurism. The blood that is effused into large cavities, such as the chest, rarely coagulates, or at least the main portion of it.

Woolsey[1] states that the power of locomotion may be preserved after wounds of the carotid artery, but that the power of struggling is lost. From this fact he says it may be possible to distinguish between homicide and suicide. If wounds to large vessels do not cause death by hemorrhage, then gangrene, etc., usually does. The entrance of air into wounded vessels may produce fatal results, although it is possible for large quantities of air to gain entrance to the arterial circulation without terminating in death.

Wounds and Ruptures of the Diaphragm.—The diaphragm may be injured by weapons which enter the thoracic or abdominal cavities, by falls or crushes, by disease, and by fracture of the ribs. Injuries to this muscle almost always involve the organs situated either above or below it. Therefore, the prognosis is always dependent on the concomitant injury to the immediate organs. Wounds of the diaphragm are usually either accidental or homicidal in nature. Death is due to the injuries of the adjoining viscera, and not to the wound in the diaphragm, as it is usually like those of other muscular parts and readily amenable to treatment. If, however, the diaphragm be ruptured, the complications increase the dangerous character of the injury; not on account of hemorrhage, for that is slight, but really on account of what is termed phrenic hernia, which may become strangulated and be the cause of death. This result may not be immediate, but may occur a year or even a greater length of time after the receipt of the injury. In this connection it is important for the medical examiner to study carefully the history of the case, so that his opinion may connect the death with the injury under investigation. This form of hernia follows especially lacerated wounds, even after their cicatrization. The medical examiner should recollect that a herniated person may succumb to the fatal influence of some other cause; or, again, he may acquire a phrenic hernia

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

as the result of a sudden exertion on his part, or of a blow ; or a sudden exertion may strangulate a pre-existing hernia. Persons suffering from these herniæ are more or less incapacitated, but they may still have the power of locomotion. Devergie states that rupture of the diaphragm with hernia exists more often on the left side in the central tendon anterior to the crura and at the point of junction of the left muscular slip. Hernia may also occur on either side of the ensiform cartilage, particularly on the left side.

Wounds of the Abdominal Walls and Viscera.—These are either accidental or homicidal in nature, and only suicidal in the case of delirious or insane patients.

Contusions of the abdomen are more serious in their effects than those of the chest. They generally result from blows, the kick of a person or of a horse, or the passage of a vehicle over the body. They occur with or without rupture of the abdominal viscera. In contusion without the involvement of the viscera there are nausea, vomiting, great prostration, and shock. The rectus muscle may be involved so as to rupture, or hæmatomata may be formed, followed by abscess.

Incised and punctured wounds of the walls of the abdomen may prove fatal by involvement of the epigastric artery. So, likewise, contusions may result fatally from shock to the solar plexus of nerves. The yielding nature of the abdominal parietes to external shocks may cause the force of a blow to be expended on the contained viscera, and thus set up peritonitis or produce rupture of the liver, spleen, stomach, or intestines. Such severe injuries to the organs mentioned may often be inflicted without any extra-abdominal marks of violence to account for the trouble. Blows on the abdomen are not always followed by ecchymoses or even abrasions. Extravasations of blood, on the other hand, are often found, post mortem, in the muscular sheaths without there being any external signs indicative of violence. If, on inspection of the body, the medical witness finds no abrasions or ecchymoses, nor any evidence of violence, he should be extremely cautious in attributing the extravasated blood found between the muscles to violence.

Contusions with laceration of the viscera are characterized by pain, great shock, and the persistence of collapse. These are accompanied by the signs and symptoms of internal hemorrhage if the solid viscera or the vascular portion of the peritoneum be involved, or by a rapidly developed peritonitis in case the hollow organs are ruptured. (The signs indicative of the rupture of any of the viscera will be given later on ; *vide* Individual Viscera.) The cause of death here is usually due to internal hemorrhage, to shock, or, as is usually the case, to septic peritonitis. In determining what organs are involved in the injury, the medical examiner should, in all cases, consider the part of the body which received the greatest force of the violence. Taylor mentions the case of a pugilist who, during an encounter with another, was hit on the abdomen, with the result that he was instantly killed. The autopsy showed no external or internal injury, and the physician who made

pronounced the cause of death to be sudden shock, which no doubt was true. On trial, the judge, in his charge to the jury, left it to them to decide whether the fatal result was due to the blow or not. If they could not form an opinion as to the real cause of death, or if they should imagine it to be the result of excitement, independent of the blow, the accused should be acquitted, a verdict of which was returned. Here, although the blow was seen to be struck, and was a sufficient cause of the fatal issue under the circumstances, the jury doubted that the blow on the abdomen was the real cause of death because there were no visible marks, externally or internally, to account for the death. Any medical knowledge on the part of the jury would have dissipated this apparent difficulty.

Penetrating wounds of the abdomen involve the peritoneal cavity. There may be simple penetration without visceral injury or protrusion ; or penetration with visceral injury, but no protrusion ; or penetration with visceral protrusion, but no injury ; or penetration with both protrusion and injury.

Sometimes wounds of the abdominal organs are cured spontaneously, but in the majority of instances they result in death if not subjected to surgical treatment. Penetrating wounds without visceral injury may result fatally if they become infected. On the other hand, they heal rapidly and without danger unless they are extensive. The examination of such wounds with the finger or probe should not be indulged in too freely unless a laparotomy is to be performed, as a non-penetrating wound may be converted into a penetrating one, or the viscera may become infected.

The *liver*, from its structure and position, is subject to rupture from the infliction of violence to the abdomen ; or it may be wounded by a fall, or even by sudden muscular action if the organ be diseased. Death is usually due to hemorrhage, to shock, or to peritonitis. These injuries are dangerous according to their extent and depth. Rupture of the liver is characterized by pain in the right hypochondrium, increased hepatic dulness, the signs of internal hemorrhage, the blood collecting in the right iliac region or in the pelvis ; and subsequently there is vomiting of a bilious nature, clay-colored stools, and sugar in the urine. These injuries may be produced without being attended by any external marks of violence, and the liver may be ruptured from violence applied to the chest. The hemorrhage from injuries to this organ is slow unless the vena cava, portal vein, or a large branch of either of these be involved.

Although these wounds or ruptures are not instantly fatal, they may become so under other circumstances. Sometimes the wounded person can move about, etc., a fact which has been advanced by the defence to show that the injury was due to other than the particular violence in question.

If the *gall-bladder* be involved, fatal results are apt to follow in consequence of the effusion of bile. This is usually the cause of death here, and not hemorrhage. This organ is especially liable to rupture if gall-stones be present.

The *spleen* may be ruptured as a result of disease or of violence. That

which has been said concerning the liver is equally applicable here, as same class of injuries affect the spleen, and death is caused in the same w These injuries are characterized by pain in the left side and increased sple dulness on percussion. It is important to remember that an enlarged softened spleen is easily ruptured, even by slight muscular exertion. De is generally due to hemorrhage, although it may follow shock. Periton rarely follows these injuries. The internal bleeding accumulates in the low left side of the abdomen or in the pelvis ; the blood is rarely in a state of agulation. The healthy normal spleen cannot be ruptured except by dir violence.

The *kidneys* may be ruptured by concussion so as to cause death. slighter injuries follow, the recovery of the wounded person may be expecte Wounds of this organ are of rare occurrence on account of its deep situatio in the abdominal cavity. The danger to be looked for in these injuries aris from the extravasation of urine, and the consequent inflammation. There ar lumbar pain and tenderness, a frequent desire to micturate, and hæmaturi In very severe cases there may be the signs of bleeding and of shock. Deat may result rapidly from hemorrhage, collapse, or more slowly from perito nitis, abscess and septic infection, or from uræmia if both organs are dis eased. Persons suffering from ruptured kidney may be able to move about etc., as is the case with the liver and spleen, but this power is lost if there be free bleeding.

The *bladder* may be ruptured by a blow or kick, or it may result spon taneously from over-distention, although in such cases, if the distention be caused by stricture, the urethra is more likely to weaken. The plea of spontaneous rupture of this organ may be advanced by the defence in a case of homicide. Ruptures of the bladder take place most frequently in the upper and posterior part where the viscus is covered by the peritoneum. They are usually of a vertical direction. On account of the extravasation of urine into the peritoneal cavity, peritonitis results; or, if the injury be at the anterior part of the organ, the extravasation occurs into the loose cellular tissue of the pelvis, producing cellulitis with secondary peritonitis or septic poisoning.

Rupture of the bladder may occur without any apparent evidence of external injury. Spontaneous rupture may be due to the weakened con dition of the organ produced by the pressure of a calculus, or by tubercular, syphilitic, carcinomatous, or ulcerous deposits. The usual period of death from these injuries is from three to seven days ; in some cases the victim may die suddenly from the shock, while, again, he may survive for fifteen or more days. The patient may be able to walk after the injury in some cases, and at first show no symptoms of the serious wounding.

Punctured wounds of the bladder may be so small as to cause slow ex travasation of urine ; or the opening may be valvular, and the urine only escape during non-distention of the viscus.

The *stomach and intestines* may be ruptured by crushes, blows, and falls,

or by disease. Furthermore, punctured wounds, or occasionally incised wounds, of the abdominal wall may involve them. The injury, if to the stomach, is generally rapidly fatal, and is characterized by radiating pains, vomiting of the stomach-contents, together with blood, the rapid development of general meteorism, and tympany over the liver. If the intestines are involved, then we have intense radiating pains, vomiting, at first from the stomach, then bile, and lastly blood. The stools are bloody, and there is tympanites with dulness in the flanks and percussion resonance over the liver. Both ruptures and stab-wounds of these viscera may be multiple. Of the intestines, the ileum is most liable to rupture, the jejunum less so. Hemorrhage, as a rule, is not excessive in these injuries, while in wounds it may be alarming. The greatest danger is the liability of the injured person to septic peritonitis, due to the leakage of the stomach and intestines, or death may occur speedily as a result of shock. Disease may so weaken the walls of both stomach and intestines as to cause spontaneous rupture; and it is well to recollect, in this connection, that a slight injury may cause rupture, due to the weakened condition of the gut. The attempt of the injured person to walk, etc., may be successful. As with injuries to the organs previously mentioned, the injury to the stomach or bowel may be inflicted without the marks of violence being apparent externally. (*Vide* Gunshot Wounds.)

Wounds of the Genitals.—These may be incised, punctured, or contused. Incised wounds are indicative of homicidal intent, for accidental cuts are rare. These wounds, however, are mostly accidental in origin, although self-inflicted wounds of the genitals are met with most generally among the insane. Wounds of the female genitals may cause death from hemorrhage, and the fact of an incised wound being found in the labia would be strongly presumptive of assault. Contused wounds, such as kicks, or a severe blow on the vulva, may cause death from hemorrhage; they often resemble incised wounds. Sometimes it is alleged by the defence that contused wounds of the female genitals are inflicted post mortem. The distinction between ante-mortem and post-mortem wounds has already been alluded to (*vide* p. 272); but, in addition, it may be said that in fatal contused wounds of the vulva, death is caused by bleeding or extravasation of blood, conditions which would not be present if the injury was inflicted post mortem.

Sometimes the physician will have to determine between accidental, suicidal, and homicidal injuries of the genitals. Injuries of these parts, when self-inflicted, comprise castration and partial or entire amputation of the penis. Demarquay mentions the case of a drunken man who excised his genitals and died the next day from hemorrhage. The dangerous character of these wounds is proportionate to the hemorrhage.

Wounds of the Extremities.[1]—The degree of danger in these injuries

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[1] *Vide* surgical works. The reader is also referred to Gunshot Wounds in connection with the subject of Wounds Regionally Considered.

depends on the vessels involved, the shock, the situation of the injury, and the existing complications, if any. These injuries are more often the cause of civil than of criminal suits. The wounds to be considered here are those of an artery or vein, or both ; those of nerves, muscles, tendons, and the soft parts of the limb. Then the medical examiner must note whether there be wounds of the joints, fractures, dislocations, contusions of the bones, etc. ; also whether the limb be deformed, disabled, or both.

CHAPTER XXVII.

GUNSHOT WOUNDS.

Remarks—Danger of these Wounds—Was the Wound inflicted before or after Death?—Evidence from the Weapon and Projectile—Deflection of the Ball—Wounds from Shot, Wadding, and Powder—Was the Weapon fired Near or at a Distance?—Complicating Conditions.

Gunshot Wounds,[1] whether caused by small or large shot, by bullets, or by small pebbles thrown by any sufficient force, as by a blast, are essentially classified as contused lacerations. They differ from other wounds chiefly in the fact that the vitality of the tissue involved is destroyed and instantaneously changed into a disintegrated pulpy mass, which may be found in the course of the wound as dead tissue.

When the bullet traverses the body two apertures will be noticed,—the open wound of entrance, which is round and clean, and the corresponding one of exit, which is usually less regular, jagged, and smaller, although at times the reverse is found to be true. The course of the wound is open, and appears on dissection as a blood-stained line ; but if the injured person has survived the wound for two or three days, slight inflammation will have begun, and the sharp red line will still be seen against the other tissues.

The contusion of the part struck by the bullet is so complete and the bruising force so short that ecchymosis is rarely observed, and the surrounding parts are scarcely ever involved. If, however, the bullet strike the part only when nearly spent, the skin may not suffer any solution of continuity, although the resulting contusion may have such effects as to injure deeper parts. Thus, Conner[2] mentions a case where both bones of the leg were extensively shattered from the force of a large piece of shell which did not break the skin ; and Macleod reports an instance where a round shot struck the scale from an officer's shoulder and, glancing off,

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[1] For the effects of gunshot wounds upon the various tissues the reader is referred to the larger works on surgery.

[2] Ashhurst's Encyclopædia of Surgery.

azed his head, causing instant death. The scalp was uninjured, but so mpletely smashed was the skull that its fragments "rattled within the lp as if loose in a bag." (*Vide* Contusions.)

If bone be struck by a bullet, the violent impact will produce disintetion, as with the soft parts or fractures, generally radiating in character. contusion may not be dangerous, although at times the part struck is pletely devitalized. The common result of these contusions is to light lestructive inflammation.

)anger of these Wounds.—On account of their dangerous character, hot injuries require the most careful consideration of the medical jurist. are exceedingly dangerous to life, their gravity varying according to nportance of the part wounded, and also to the size and velocity of the t. It is also important to remember that, *cæteris paribus*, a gunshot d is less dangerous if lodgement of the ball has not taken place than a rating injury with lodgement.

eath occurs either from hemorrhage or shock to the nervous system. ormer is seldom profuse, except when great vessels are injured. Frely the form of the wound is such as to preclude the possibility of nal bleeding, while a fatal internal hemorrhage may be going on. Still, ds of the great blood-vessels are not necessarily immediately dangero life, since great vessels like the aorta have been injured by shot, and ife was preserved for weeks. Death from shock often follows these ds. As in other wounds, it is proportioned to the severity of the r. The secondary effects are those of inflammation, the degree of 1 depends upon the health of the injured person, the situation of the d, the size of the bullet, and the surgical assistance rendered. (*Vide* nds.)

Vas the Wound inflicted before or after Death?—This question arise in a case of homicide. Although it is not always easy to answer important query, the medical witness may recall the principal characics of ante-mortem wounds. (*Vide* Wounds.) These are: more or less ion, more or less hemorrhage, extravasation of blood into the tissues, her with the presence of coagulated blood or clots. Post-mortem ids show scarcely any extravasation of blood, unless from a superficial l, when it would be venous in character and non-coagulable. Moreover, ula are not to be found in the track of the bullet.

:vidence from the Weapon and Projectile. (*Vide* Wounds.)—medical examiner should note the following points in determining facts ding a suspicious case of gunshot injury: (1) the position of the on, whether within the hand of the deceased, or whether it had been so d by another; (2) the presence or absence of blood upon it; (3) the ations or not of the recent discharge of the weapon; (4) the number rtridges or bullets discharged; (5) the calibre of the weapon; and (6) eight and dimensions of the ball discharged. These points of evidence, tainable, are of great value.

The determination of the time elapsed between the death of a person and the firing of a shot is hardly possible, although some approximative conclusions may be drawn, as follows. When the weapon is discharged, one of the products of the powder is potassium sulphide mixed with charcoal. Upon its exposure to the atmosphere part of it is converted into potassium sulphate, which forms with water a neutral solution, and produces with the acetate of lead a whitish precipitate. "If," says Semple, "a finger introduced into a gun-barrel is blackened, and if the barrel is free from rust or crystals of protosulphate of iron; if the solution (made by washing out the gun-barrel with distilled water and the washings filtered) is of a yellow color, smelling strongly of sulphuretted hydrogen, or yielding a black precipitate with lead acetate, the weapon has not been discharged more than two hours. If the color of the interior of the barrel is less dark, but contains neither crystals of ferrous sulphate nor rust, but the solution (made as above mentioned) shows traces of sulphuric acid when tested with chloride of barium, the period that has elapsed is more than two but less than twenty-four hours. If many spots of rust are observable in the interior, and if the solution shows indications of iron when tested by ferrocyanide of potassium, at least twenty-four hours, perhaps six days, have intervened. If the rust is in greater abundance, the solution no longer yielding any iron reaction, at least ten days, and perhaps fifty days, have passed since the discharge of the weapon."[1]

The medical examiner should note how many cartridges or bullets have been discharged from the weapon, for comparison with the wounds, if there be more than one, on the body, or with the evidences obtained from the place where the shooting occurred. Thus, if he discovers, on examination of the weapon, that four of its chambers are empty, while but two wounds are in the body, evidence of the other missiles may be obtained by an examination of the room or locality. The recovery of the shot from the wound may have some bearing on the case if other missiles of similar shape and size are found on the accused; or, if it can be measured, it may be found to be of a kind to suit the calibre of the weapon used by the prisoner. "In a brawl in Troy some years ago," says Balch, "shortly after the second trial of Jesse Billings, a man was shot. More than one shot was fired, and by different persons. One arrested for doing the wounding was freed by the medical witnesses who had held the autopsy proving absolutely that the ball recovered from the dead man could not have been fired from the pistol known to have been in the possession of the prisoner at the time of the brawl, and which was taken from him on his arrest. Had the doctors not saved and produced the ball, the man would probably have stood a fair chance of being convicted of homicide, for the testimony presented pointed strongly to him as the one giving the fatal shot."[2] If the bullet taken from the body for comparative purposes is found to weigh more than any of the missiles found in the chambers of the weapon supposed to have caused

[1] Forensic Medicine. [2] Hamilton's System of Legal Medicine.

injury, then the weapon in evidence could not have been the cause of wound.

Does a bullet lose weight during its passage through the bore of the pon and the air before it strikes the body? The passage of a lead bullet ugh the bore of a weapon produces sufficient attrition to reduce its ght, although the "leading" is subject to variation according to circum-ces. "Patching" the bullet and lubrication are often resorted to in order educe the attrition. A bullet which has been partially fused loses the fused s either in the bore of the weapon discharging it or in the air, or in both, its irregularity of form will send it in an irregular line to its destination. he Billings case, which is quoted in full below, several interesting ques-s relative to the action of the tissues of the body upon a bullet passing ugh them, etc., were considered. The following interesting account of case is taken from Balch's contribution ("Homicide and Wounds") to nilton's "System of Legal Medicine." ". . . Mrs. Jesse Billings, who, le sitting sewing opposite a window, was killed by a bullet fired from out-of the house, and which entered her head but did not go out of it. Her band was arrested for the murder and tried twice, the jury disagreeing in first and acquitting in the second. The time was the evening of the 5th of e, 1878. She was sitting with her left side toward the window and about ee feet from it; the lamp on the table was burning, and the window-shade s up. As soon as the shot was fired she fell to the floor dead. The autopsy wed that the ball had entered the left side of the head, about half an inch ove the opening of the ear, and ploughed its way across the base of the ull to the opposite side, where it caused a triangular fracture of the mastoid rtion of the right temporal bone, forcing this through the skin so the frag-ent protruded. The ball stayed in the skull at the base of this triangular gment, and partly buried in the posterior surface of the right petrous por-n. The autopsy was carried no further than the head, but, as certain estions concerning the size of the bullet and its action upon the skull came in the first trial, the body was raised and head removed, that more careful amination could be made of it. The case was evidently one of murder, d many questions relating to the killing and in connection with the weapon ich the people claimed was the one used were relegated to the medical tnesses. It was claimed by the defence that the ball would have gone rough the head if it had been fired from the rifle or carbine the people put evidence. It was thought some little retarding of the bullet might have en caused by its first going through the window-pane, and another point sed by the defence was that the weapon would not carry unexploded wder a greater distance than one foot, and at this distance the moving dy of gases of the discharge would blow the window-glass from its frame : ce this point. Another apparently strange fact was that the hole in the ss through which the bullet had passed was enough smaller than the ibre of the gun (.44 inch) as to prevent an unfired ball going through hout breaking off the edge of orifice.

"All these questions were acted upon by the medical men engaged on both sides, for the answers had to do with the wound found in the head of Mrs. Billings. The evidence of the wound itself was that a weapon of forceful fire and large calibre had made the injury. The ball—at least so much of it as was found in the head—weighed but one hundred and sixty-five grains, while an unfired ball of the cartridge used in the carbine weighed two hundred and twenty grains, and the recovered bullet was very much upset. From the wound and the ball found it was evident that pistol or rifle had been used, for a smooth-bore was out of the question, lines showing the impress of the lands and grooves of the barrel being found upon the bullet. The district attorney wished two questions definitely answered, and these were, What effect would the ball have upon the bone? and What the bone upon the ball? To decide these it was considered necessary, supposing the carbine to be the weapon, to know what force a ball fired from it would have, for the ball did not go out of the head. The piece was therefore tested at the United States Arsenal at Springfield, Massachusetts, permission to do so having been obtained from the War Department. It proved to be a weapon of low velocity, the mean being 998.8 feet per second. This brought the energy of the ball down to 521.1 foot-pounds, or about half of what it would have been had the velocity been up to that of an ordinary rifle, as stated by the defendant's experts to be about thirteen hundred to fourteen hundred feet per second. The force of the bullet was not so very much more than a ball fired from an army revolver; and the force being found so much less than was expected, the stopping of the bullet in the head was not such a mystery, especially when the thickness of the skull was taken into account (and it was abnormally thick and dense), and also the course of the ball. Tests were also made at the arsenal to determine whether the bullet, passing through glass, lost any of its velocity. It was found that no appreciable effect was made by the glass. The ball struck almost its full diameter on the base of the left petrous portion, and crumbled this part of the temporal bone so but little of it could be recognized. The ball, having ploughed its way through this bone, passed over to the right petrous portion, into which it crushed a little, and expended its force in breaking the triangular piece of bone from the mastoid portion, and forcing this outward through the skin and tissue. The effect the ball had upon the bone was to fracture the skull in different directions, but the most noticeable effect was the almost complete disintegration of the left petrous portion. This might be described as being ground up. The bullet seemed to have the effect on it that is produced on the contused tissue when the wound is in the soft parts, and this complete destruction may partly be accounted for by the somewhat brittle character of the petrous portion, it containing hardly any cancellous bone. It yielded therefore, more readily to a sudden and forceful contusion or concussion, and went all to pieces. Upon the rest of the skull the action of the bullet was what would be expected and is usually seen,—lines of fracture radiating from the point of contact and following the general laws of physics.

"The action of the bone upon the ball was to use up part of its lead. The first impact with the bone did the upsetting; but its having to plough through such fine, sharp particles as the fracture reduced the petrous portion to caused more loss of substance than would appear reasonable if it could not be shown by other experiments to be probable. We may assume the ball to have been of two hundred and twenty grains' weight before firing. It was one hundred and sixty-five grains when found in the head. To see what effect might be had upon a bullet following as nearly as possible the track of this one, I made six experiments of shooting at cadavers, and then examining the heads afterwards, care being taken to recover every particle of lead possible. In the last series the bullet followed more nearly the track of the Billings ball. The subject was badly decayed, and the skull old and very thin; but the ball struck the base of the left petrous portion fairly, and had but strength enough to fall out of the head on the right side upon the table, and then roll to the floor. I give the record of this experiment, as made at the time. Sixth shot, no glass, distance ten feet from subject:

Weight of ball		220 grains.
Weight of ball recovered	159.291 grains.	
Weight of lead found	000.000 grains.	
Total weight of lead recovered	159.291 grains.	
Loss not found	60.709 grains.	

"The other five bullets lost anywhere from 3.975 grains to 50.557 grains, and by loss I mean total loss, the lead not being found even in small particles. But in none of the first five experiments did the bullet follow the line of the Billings ball, and nowhere do we find an equal amount of weight lost until the experiment quoted where the petrous portion was traversed by the bullet. These experiments then proved that the ball taken from Mrs. Billings's head could have weighed two hundred and twenty grains before being fired, and proved, further, that for such a bullet to lose as much as was the case in the Billings ball it would have to travel through considerable bone, which would cause enough attrition to reduce its weight.

"But these two questions out of the way, and the third one of the gun being of comparatively low force, how could the bullet be for a weapon of .44-inch calibre when the hole through the window-pane would not admit of such a ball passing through it? This was answered by a number of experiments, firing at glass set in sashes, both glass and sash being similar in size and weight to the window through which the fatal bullet had gone. The notes show for these tests the following: 'Ballard carbine, old style, .44-inch calibre, long cartridge, two hundred and twenty grains lead, twenty-eight grains powder. Experiments made May 8 and 10, 1880, in the Tenth Regiment Armory, Albany, New York. Shots fired through glass set in sashes; glass twenty-eight by thirteen and one-half inches, double-thick, American make.' The distance from muzzle to glass was generally ten feet,

but other distances were tried, from seventy feet down to two. At the last distance the glass was blown out of the frame. As a summary the notes state :

Balls unable to pass	1
Balls barely passed	3
Balls passed	18
Cartridges passed	21
Glasses blown out	2
Total	45

"From these tests, in forty-five shots one hole in the glass would not permit an unfired ball to go through without further fracture. The force with which a bullet strikes a pane of glass acts precisely as it does on the tissue when it enters or wounds the soft parts of the body. It disintegrates by the concussion the part struck. So in the glass the action is so rapid that the part struck is punched out before it has time to call on the surrounding part for help, and the glass yields a trifle to the force, resuming its natural position after the momentum has passed on. Again, the temperature of the air and its humidity have something to do with the glass yielding. Another piece of evidence, then, in the case under discussion was shown to prove that the carbine could have been the weapon.

"It was claimed by the defence that the gun could not carry unconsumed powder farther than one or one and a half feet. It should, however, be borne in mind that in fixed ammunition the bullet is driven into the cartridge directly upon the powder, and generally the heel of the ball is greased before being put into the shell. As long as that grease holds on to the ball, just so long may a grain or two of powder cling to it and be carried great distances. As the firing experiment at glass had proved that within the distance of two feet the gases would shatter the glass, it would have been impossible for the carbine to have been the weapon if it could only carry unburned powder one foot, and powder or marks of powder were found in the window-sash. To determine this question more experiments were made. Seven boards, of about fourteen inches by ten inches, were fired at with the carbine, the distances from the muzzle being from ten feet to two feet. The boards were produced in court, and tests then made of what was supposed to be powder implanted in them. A platinum wire point, heated by a galvano-cautery battery, was brought in contact with the grains on the glass. From eight feet down to two distinct flashes and smoke were elicited, showing the grains to be powder. At ten feet no flash could be gotten, but the marks were considered to be those of powder. The experiments were, however, proof that the carbine could have been the weapon, for at eight feet the window pane would not have been blown out by the discharge, and the gun could implant unburned powder into boards that far from its muzzle.

"The evidence of the wound, therefore, was in support of the proper claim that the carbine shown by the testimony to belong to the prisoner

d which had been hidden in an old well on his farm, could have been and obably was the weapon with which the crime was committed. But, as id before, when speaking of the nearness of the muzzle to the gunshot ound found, the fact that it might have been the weapon was conclusively own only by the various experiments made with it."

Among other points to be considered in the investigation of gunshot ounds are the following : (1) the number, size, and direction of the wounds ; 2) the presence or not of marks of violence and of blood-stains ; (3) the mount of blood lost, whether clotted or not ; (4) the presence or not of ains upon the clothing ; (5) the direction of the effused blood ; (6) the ourse of the wounds in the body ; the presence or not of foreign substances splinters of bone, fibres of tendon or aponeurosis) in the course of the issile ; (7) the condition of the lips of the wound, whether there be inverion of the wound of entrance and eversion of the corresponding one of xit, or not ; (8) the condition of the weapon, of its barrel ; or if a revolver, f its different chambers ; note whether they are clean or not, etc. ; (9) the eculiarities, if any, of the cartridges ; whether the primer is marked by the ammer, and the name of the maker, etc. ; (10) the size and weight of the ullets used ; (11) the weight and number, if shot were employed ; (12) the ondition of the sights of the weapon, whether displaced or loosened, etc.; lso note the "trigger-pull ;" and (13) the places of impact of the various ullets, as upon the wall, etc.

The above points, if known, may be of vital importance at times. It is almost needless to remind the medical examiner regarding the value of noting (1) the time at which the wounded person died ; (2) the time of infliction of the injury ; (3) the situation and attitude of the body of the deceased ; (4) the condition of the clothing ; (5) the appearance of the body ; (6) the state of countenance ; (7) the probable age of the deceased, his condition of nourishment, etc. ; (8) the nature of the surroundings, such as walls, fences, windows, rooms, etc. ; (9) the presence of cadaveric rigidity ; and (10) whether the position of the body was changed, etc.

The obliquity of the wound through the skin may, in some instances, indicate the direction from which the bullet came. One side of the orifice of the wound may show more marked staining and inversion than the other, showing that the impact of the missile was firmer ; so, likewise, the approximate course of the ball through the tissues may be shown by the discovery of splinters of bone, etc., along the track of the ball. (Hall.) The direction of the blood lost may indicate the position of the victim at the time of the wounding. However, it is well to remember that there may be no external evidence of bleeding at all, since the hemorrhage may be entirely internal. In regions where the subcutaneous accumulation of fat is great, the orifice of the wound may appear everted instead of inverted.

Regarding the weapon, it is important that the medical examiner makes note of the size, make, number or mark, weight, and length of the barrel, and whether rifled and hammerless or not. He should further observe any

peculiarities of construction, etc., and, regarding bullets, remember that it is possible for the assailant to employ many different varieties in the same weapon. Hall[1] says, "The sights of the weapon should be examined with care, especially to learn if they have been displaced or loosened. As the sights are detachable, it is perfectly possible that an accidental shooting may have occurred from a change in the position of one of them, as in the foolish attempts to shoot a pipe from one's mouth or an apple from the head. I have known many wild shots made at a target and at game from this cause, although they are more common from changes in the elevation of the rear sight. . . . It should be noted that a very slight movement of the sight is needed, in short weapons especially, to produce a considerable deviation in the course of the bullet. . . . The trigger-pull, varying from almost nothing in guns with a set trigger to even twenty or thirty pounds in old muskets, should be noted, for it may make a great difference in the accuracy of aim possible with a given weapon. Many shooters pull a hard-shooting rifle to the right, even if using great care. In the case of the pistol, if the trigger-pull is excessive, one may pull it entirely off the mark. . . . In some revolvers the notch serving to hold the hammer at full cock is filed away, so that the weapon will not stay cocked, but is discharged either by raising the hammer and allowing it to fall suddenly with the thumb of the hand holding the stock, or with the fingers of the opposite hand. The trigger is tied back in some cases to attain the same end. In my own practice I have seen the results of two accidental shootings from pulling the trigger in excitement in handling a double-action weapon, which does not require to be cocked, but is discharged by simply pulling the trigger. In one of the cases the revolver was discharged in the pocket of the owner while he was hunting for a man with whom he had quarrelled, and the resulting wound prevented him from pursuing his antagonist farther. It was testified in court that a certain pistol with which a woman had been killed would not remain cocked, after having tried it several times to make certain of its condition. After the case had been given to the jury, in explaining the matter to a friend, I tried it again, and it remained at full cock. Although I tried it many times afterwards, it did not do so again. In this case enough of the notch remained to hold it this particular time, although it could not ordinarily do so. Fortunately, the error was of no serious importance in this case; but if the weapon had been handled when cocked, the slightest jar might have caused its discharge."

Regarding the post-mortem examination, especial attention should be directed toward those organs in which occur the most common causes of death. These include the brain, the heart, the great vessels, and the viscera. Furthermore, if there be evidences of an operation having been performed, then it becomes the duty of the medical examiner to ascertain, if possible, whether this method of treatment was absolutely necessary to preserve life,

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[1] New York Medical Journal, vol. lxii., No. xii.

FIG. 1.

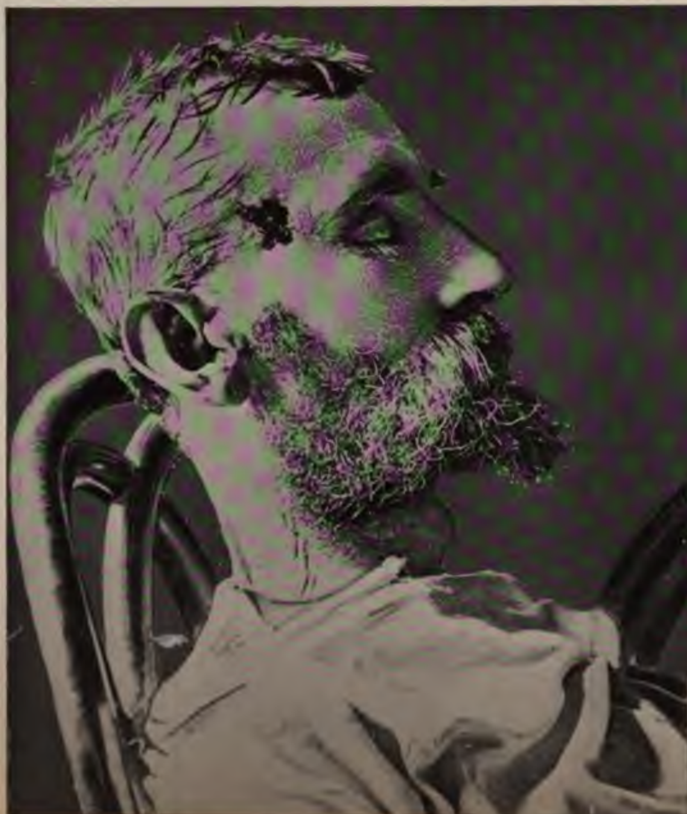

FIG. 2.

The above reproductions of a case of suicide by pistol-shot show both the wound of entrance and that of exit. The weapon was held close to the right side of the

or whether death could be ascribed to the injury inflicted by the assailant or to the operation.

In some cases it may be necessary to examine the contents of the stomach. This is especially so where there is suspicion of the existence of poisoning as well as gunshot injury.

The question of the *homicidal, suicidal,* or *accidental* character of these wounds must generally be settled by the appearance and situation of the wounds or by the surrounding circumstances. (*Vide* Wounds in General.) Wounds inflicted with suicidal intent are most often directed toward a vital part; besides, the skin is stained or burnt[1] and the wound gaping and lacerated, etc. These conditions may likewise exist in wounds inflicted accidentally, but here the relative position of the body of the deceased and the weapon will show the presence or absence of design.

Was the deceased killed while running or when coming toward the person who fired? The situation of the wound of entrance, whether in front or behind, will determine the answer to the question.

Deflection of the Ball.—This is readily produced in the body by the ball striking obliquely such resisting surfaces as bone, tendon, etc., but, on account of the modern rifle bullets, the converse may be true, especially if the ball be long and pointed and fired from a rifled barrel.

A remarkable illustration of the deflection of a ball is related by Wharton and Stillé. A German student was wounded in a duel by a bullet striking him in the neck. Instead of producing a fatal injury, the ball had struck the larynx and then passed completely around the neck, so as to lodge on the opposite side of the thyroid cartilage. It was taken out by simply cutting through the skin. Cases are recorded where the bullet passed halfway round the chest or abdomen and was afterwards found lodged in the back. Taylor states that a bullet which struck and entered the ankle was afterwards found at the knee; and in another case a bullet which penetrated the back of the left shoulder made its exit below the right ear. This same deflection may take place when the weapon is fired near to the body, as in suicide. The causes of this departure of the missile from its true course are probably the obliquity with which it strikes and the rotatory motion imparted by the rifling of the weapon. Frequently fascial resistance will be so great as to deflect the shot, the line of the new course varying according to the shape and velocity of the missile, being considerably greater in the case of the round than in that of the conical ball. The density and structure of the muscular tissues and aponeuroses also influence the directness of

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[1] The writer has seen a case of suicide by shooting through the head in which no evidence of powder-stain or mark, burn on skin or hair, was apparent.

In the *Foglia case* the writer testified that it was possible for a person to shoot himself without leaving a powder-stain or mark, or without singeing the hair. In this case the defendant, who was tried for murder in the first degree, was convicted of manslaughter in the first degree. (*Vide* illustration.)

the course of a ball in its passage through the body, with, of course, the exceptions just noted.

Wounds from Shot, Wadding, and Powder.— *Wounds made by small shot* vary in appearance according as the distance from which the charge came is near to or far from the body. Fatal results sometimes follow such wounds. According to Lachese, who experimented on dead subjects, the distance from which the shot must be fired to produce a clean, round opening or wound, similar to that produced by a rifle-ball, is about ten or twelve inches from the surface of the body. A distance of from twelve to eighteen inches produced an irregular opening with lacerated edges, while at thirty-six inches there resulted a scattering of the shot, the central opening being lost. From these results it may be possible for the medical examiner to form an opinion as to the distance at which the weapon was discharged. Paley cites the case of a boy who was accidentally shot in the neck by his own gun (carrying number eight shot) with fatal results. He was found lying forward of the muzzle of the weapon so that it was almost in contact with his neck. The shot produced a large round wound, one and one-half inches in diameter, the margins of which were slightly blackened by powder. The corresponding wound of exit on the posterior part of the neck, at the third vertebra, was hardly an inch in length, being entirely superficial in character, a fact probably due to the greater part of the charge being lodged in the body.

Lowe states that it might be possible in some instances for a discharge of small shot to produce a round aperture at a much greater distance than ten to twelve inches from the body. It hardly seems probable, however, that a wound from small shot can be mistaken for one the result of a bullet.

Small shot rarely pass entirely through the body, unless fired so near as to produce a clean, round aperture.

Wounds produced by wadding and gunpowder may cause serious and even fatal results, especially when fired close by. It has happened, says Taylor, that individuals bent on suicide have neglected to put a bullet into the pistol ; but, nevertheless, the firing of the charge into the mouth, from the effect of wadding only, has produced serious injury and hemorrhage. Death has resulted from the discharge of wadding from a cannon. It ofte happens that a part of the clothing of the individual may be carried into th wound, and death follow from hemorrhage or secondary causes. Tayl mentions the case of a man seated in a box at a theatre, who had one his arms broken above the elbow by the discharge of a piece of greas newspaper, tightly rammed home, from a small cannon on the stage of t playhouse.

Gunpowder alone may cause serious wounds, especially if exploded ne an exposed portion of the body. Such wounds are generally lacerated appearance, and may be darkened or blackened, and even burned. If th grains of powder be coarse, the wound may simulate one produced by ver small shot.

Marks of powder upon clothing or skin will depend for their presence o

listance of the weapon from the body, and also upon the variety of arm loyed, together with its calibre and charge. If the distance has exled ten or twelve feet from the body, powder-marks or burns of clothing hardly appear. Ordinarily it may be stated that the muzzle of the pon must be almost in contact for the clothing or skin to burn, but it is ortant to remember that there are certain fabrics which ignite sooner n others. Powder-marks or burns of the skin usually result when the pon is held at a short distance. Lachese fired a gun from a distance of y four feet from the body, with the result that the skin was but partially ckened. By means of experiments with an old-style Ballard rifle, .44-inch ibre, holding bullets of two hundred and twenty grains, and twenty-eight ins of powder, Balch[1] established the following distances at which powderrks were possible: at two feet from the muzzle the particles were too merous to count; at four feet the result was similar; at six feet the same; eight feet, nine grains of powder; and at ten feet, five grains of powder one case and six grains in another. The suspected grains were picked t, placed on glass, and exhibited in court. They were ignited by a atinum wire point heated by a galvano-cautery battery. Distinct flashes ere elicited from those from eight feet down to two, proving the grains to those of powder, while those obtained at ten feet produced no flash.

The *Nellie Phipps case* revealed some interesting points bearing upon e subject of powder-stains. The woman was shot and killed by her lover. he autopsy showed that the bullet had entered the muscular portion of the ft arm, passed through two inches of muscle, through the upper lobe of the ft lung, thence through the arch of the aorta and the lower lobe of the right ung. It was subsequently discovered lying loose in the pleural cavity. This elicited the fact that the assailant stood very close to the body of his victim when he fired the fatal shot. There were some grains of powder on the lobe of the left ear, and the hair just above the ear was singed. Parts of the clothing of the deceased were stained with powder, especially above the spot where the bullet had entered. The writer testified at the trial that the assailant could not have been over three feet from the deceased when he fired the shot.

Was the Weapon fired Near or at a Distance?—This question may be of great importance on a charge of murder or of alleged suicide. A gunshot injury may have a wound of entrance and a wound of exit, or, as occasionally happens, but one wound, that of entrance, as the bullet lodges and does not pass through the body. Generally speaking, the wound of entrance is an irregular circular puncture with torn and lacerated edges, of a purplish or dark areola. When the muzzle of the weapon is placed near the body and fired, the skin may be more or less stained by powder, and possibly burned by the partially consumed grains of gunpowder. There may also be scorching and burning of the hair and clothing in the vicinity of the

[1] Transactions of the New York State Medical Society, 1881.

injured part. When the weapon is fired from a distance these phen are absent, and all that will be apparent is the wound of entrance, an sibly that of exit. Most authorities agree that the aperture of ent when the weapon is fired from a distance, is always smaller than that corresponding wound of exit.

Dupuytren states that the aperture in the clothing is smaller tha caused by the bullet in the integuments. Park[1] states that "it is of i tance to determine, if possible, the approximate distance at which the was fired, since the question of self-defence, for instance, may hinge evidence of this character. The charge of powder and the weight bullet being known, one may sometimes estimate this distance by the of penetration or the appearance of the bullet. Still, the nature c tissues themselves must figure largely in such consideration."

Complicating Conditions.—Of the various conditions which comp gunshot injuries, delirium tremens is one of the commonest and serious. (*Vide* Wounds in General.)

CHAPTER XXVIII.

BURNS AND SCALDS.

The Danger of Burns and Scalds—Presence of More than One Burn—Burns and after Death—Causes of Death from Burns—Post-Mortem Appeara Period of the Occurrence of Death—Wounds upon the Burned.

A burn is an injury to the body caused by the application of a h substance, fire, heated metals, solids, or fluids. **A scald** is an injury c by the application to the body of a liquid above a certain degree of Although not, strictly speaking, identical, wounds, burns, and scald from a legal stand-point comprised under the term bodily injuries. sive liquids and the strong alkalies closely resemble burns and they regarded in law.

The *intensity* of a burn is dependent upon the degree of heat ap and ranges from a simple reddening of the skin to a complete charri the parts. The form of the burn often indicates the shape and size object applied. Metals heated to 100° C. (212° F.) produce rednes vesication with coagulation of the albuminous elements of the bloo other fluids. Metals in a state of partial fusion produce burns of g severity in consequence of the adhesion of the molten mass to the s of the skin. If in a state of fusion the burn is yet more serious and d ous, but may vary in degree from slight redness to entire destructio

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

charring of the tissues. These injuries are not so regularly defined in their form and outline as those produced by heated solids. They are usually classed as scalds. *Boiling water* causes scalds of more or less severity,—so slight as to produce redness only, or so severe as to cause marked effects. These injuries are associated with vesications containing serum; but they never produce blackening of the skin or charring. In severe cases the skin is of an ashy hue, with a sodden appearance, and gangrene of the parts occasionally occurs. Boiling water or the inhalation of steam often produces internal scalds of the mouth, fauces, and larynx, especially in young children.

The effects and appearances of burns by *boiling oils* are as decided as those caused by molten metals. *Boiling sugar* makes a burn similar to boiling oil, and both may also produce scalding.

In connection with burns, the question, *Was the burn produced by the application of heat or some corrosive fluid?* may be asked the medical witness. Injuries caused by the application of sulphuric acid, etc., are not, properly speaking, burns, but, as stated before, they are so regarded by the law, and hence will be so considered in this place. The cause of the burn is usually determined by the color of the injured part. Thus, *sulphuric acid* produces a brown stain, while that of *nitric* and *hydrochloric acids* is yellow. The most common seats of such injuries are the face and hands. Acid burns are easily differentiated from heat burns by the condition of the eschar, which is soft. Other distinguishing points are the absence of redness around the injury and the non-existence of blisters. The eschar readily sloughs away, and the wound heals by granulation. Blackening of the skin or scorching of the hair exists. Generally these injuries are not fatal, no case of death being recorded; but, as in the case of "vitriol-throwing" with malicious intent to injure, dangerous injuries might result. Stoddard[1] says, "It is not possible to distinguish a post-mortem from an ante-mortem burn by an acid when no vital reaction has taken place." (*Vide* Mineral Acids, etc.)

A scald from hot water may often be distinguished from a burn by the uninjured state of the cutaneous hairs; but this test is only available in moderately severe injuries, as the application of hot dense liquids or fire singes or destroys them. (Morton.) *Phosphorus* may produce burns of great severity and even fatal results. Thus, in a case cited by Morton, "A young man, while journeying on a railway, lit a parlor match by scratching it with his thumb nail. A piece of the incandescent phosphorus penetrated under the nail and made a slight burn, to which, at the time, he paid little attention. After the lapse of an hour, the pain became intense, and the thumb, hand, and forearm, in rapid succession, became greatly inflamed and enormously swollen. A few hours later symptoms of gangrene were observed, and death ensued in twenty-seven hours after the reception of the burn." (*Vide* Phosphorus.)

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

The *prognosis* of burns and scalds depends to a great extent upon the amount of the surface involved or upon the extent of the destruction of the parts. The bodily condition of the sufferer at the time of the infliction of the injury may influence the favorable or unfavorable termination of the injury. These points, as well as the secondary effects of burns and scalds, must be carefully weighed and considered before giving a positive prognosis of the case.

Constitutional Effects of Severe Burns.—These are dependent upon the depth of the burn and the extent of surface involved, and are divisible into three stages,—viz., that of shock and internal congestion, reaction and inflammation, and suppuration and exhaustion. The *first stage* (shock and internal congestion) is most marked in those burns which involve the trunk and head. The sufferer complains of chilliness and of cold. The *second stage* (reaction and inflammation) occurs in a day or two after the infliction of the injury. The patient complains of thirst, and inflammatory fever exists. The internal congestion may be followed by inflammation, and meningitis, pleurisy, or peritonitis, if the burn involve the head, chest, or abdomen, may take place. Among the most important complications are duodenal ulcer and nephritis. The *third stage* (suppuration and exhaustion) follows the separation of the sloughs. The patient frequently complains of cough and diarrhœa. He may die from amyloid degeneration or pyæmia. The *prognosis* in severe burns is always bad, death from shock usually resulting within forty-eight hours. The *treatment* is both local and constitutional. A great variety of preparations have been used locally, such as starch, oxide of zinc, linseed oil and lime-water, collodion, etc. They afford protection to the injured parts, and also exclude the air. The constitutional treatment varies somewhat in different cases. Opium is indicated in all stages of severe burns. The main indications are to induce reaction from the shock and to support the depressed state of the nervous system. Alcoholic stimulants, etc., are sometimes indicated.

The Danger of Burns and Scalds.—The danger of burns and scalds to life is proportionate to the extent of surface involved by the injuries, as well as to the depth to which they extend. Extensive superficial burns are, however, much more dangerous than those which involve a small portion of the body, on account of the greater number of sensory nerves injured and the retardation of the function of excretion and heat regulation. Fatal results, especially in young children, follow such burns. The symptoms are usually stupor, somnolence, pallor of the face, and feeble pulse, with slow and stertorous respiration. These cases may sometimes be mistaken for those of narcotic poisoning. Adults and old persons have a better chance for life than children, but nervous females are as susceptible to the effects of a severe burn as the latter. Burns which involve from one-half to two-thirds of the entire skin are almost always fatal, although those involving one-third of the body are often disastrous. It is well to recollect, in this connection, that the age of the person, the constitution, the part involved, and

the character of the injury may modify the effects of even very extensive burns.

Burns of the trunk are always more dangerous than those of the limbs, the danger being increased if they are in separate patches and of equal extent. The burns caused by gunpowder are more severe than those occasioned by steam.

Presence of More than One Burn.—Taylor[1] says that when more than one burn is found on the body of the deceased, the question may arise whether they were all produced at the same time. The determination of this point, says the same authority, depends upon the presence, in any one of the burns, of the signs of gangrenous suppuration,—"of suppuration, granulation, or other changes that take place in a living body after accidents of this kind."

Burns before and after Death.—*Was the burn produced before or after death?* It is not uncommon for a murderer to dispose of the body of his victim by burning it, hoping thus to escape detection. When a body is completely burned (charred), it will be utterly impossible to state whether the burn was made before or after death; but an opinion may be formed if the burn be less extensive, although extreme caution is necessary, since the line of redness and the marks of vesication are not always present in vital burns.

The presence of *vesication*, or blisters containing serum, is, as a general thing, indicative of ante-mortem burns, although, as was stated above, it may be found wanting. Such blisters may form at once, or not for several hours; and, according to Stoddard, "a burn inflicted in a condition of great depression of the vital powers, with insensibility, may be followed by no vesication or redness, but upon reaction and return of sensation both redness and blisters may appear. In the absence of blisters, therefore, it cannot be decided that for this reason the burn was post mortem. If from a blister formed on the living body the cuticle be carefully removed, the site of the blister will present an intensely reddened base. In the dead body, if the cuticle be removed, no red base appears, but the surface of the blister becomes dry and of a grayish color. On the other hand, if the presence of blisters is noted, can it be concluded that the burn was ante mortem? While their presence affords reason for an affirmative answer, careful examination of the blisters as to their character and contents must be made in order to decide; the presence of apparent blisters is not alone sufficient."[2] Experiments made by Christison, Taylor, Tidy, and others go to show that blisters can be made post mortem, although they do not contain serum, but only air. In dropsical subjects serous blisters may be produced after death. Tidy[3] says, "Some little care is necessary to decide positively in any case

[1] Medical Jurisprudence.
[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.
[3] Legal Medicine.

the absence of vesication. A mere pin-hole aperture in the cuticle would be sufficient to allow the serum, which would otherwise collect and form a blister, to escape, and so prevent a vesication being formed. This has been noticed many times in our experience. It suggests the necessity, in cases where a question of this kind occurs, of carefully examining the cuticle with a lens for minute apertures, or for what very frequently may be noted, minute fissures. The non-elasticity, the parchmenty and unyielding condition of the cuticle resulting from a burn, is very liable to force out the serum as fast as formed, if but the slightest outlet exists."

The presence of a *red line* around the burn is regarded as another sign of ante-mortem burns. This red line is permanent and remains after death. Both Taylor and Christison state that it cannot be produced, after death, by the application of heat to the corpse.

Tidy's conclusions, as stated by Reese,[1] are as follows. "Where there are serous blisters on a dead body, the serum being thick and rich in albumen, and the blisters surrounded by a deeply injected red line, the true skin, after the removal of the cuticle, also presenting a reddened appearance, the evidence is strong that the burn was produced during the life of the person, while it is conclusive that it was caused during the life of the part. But if the blister contained air, the true skin, after the removal of the cuticle, appearing dry and unglazed, of a dull white color, or grayish ; or, if the blister contained a little thin, non-albuminous serum, there being in neither case any red surrounding line, nor any injected condition of the cutis vera, the evidence is strong that the burn was inflicted after death."

Causes of Death from Burns.—These are various, and are due to several conditions. Those which are instantaneously fatal include cases where, from smoke or from a deprivation of air, death occurs by suffocation or asphyxia. Immediate fatal results also follow those cases of accident, as in the burning of buildings, where the person is fatally injured by falling timbers, walls, etc. One of the most common, if not the most frequent, causes of death from burns is shock. The violence of this cause is such as to produce immediate death from syncope or collapse. Other etiological factors which are less rapid in their results are coma, convulsions, and tetanus. Pneumonia, bronchitis, and sudden congestion or œdema of the lungs are frequent results of this class of injuries. Enteritis, and peritonitis or ulcerations of the bowels with or without bleeding, gangrene, or septicæmia may result fatally, or death may follow exhaustion.

Post-Mortem Appearances.—These are not always well marked; while, on the other hand, the subject may be so completely burned as to preclude the possibility of an autopsy being held. The examiner, in the external inspection of a burned body, should carefully note the probable age, sex, and especially those circumstances leading to the identity of the person. The burned parts should be examined as to their condition ; also

[1] Medical Jurisprudence.

o the presence or absence of redness, vesication, or charring. The ex-t of the injury should also be ascertained, and the relative positions of burned parts and those not involved. The blisters should be examined to their condition,—*i.e.*, whether full or empty, etc. The most constant ions to be noted internally are the capillary injection of the mucous mem-anes of the alimentary canal, the bronchi, and the serous effusion into the rebral ventricles. In some cases, however, no redness of the respiratory icts will be found. If the body has been completely charred or roasted, may be possible to distinguish the bones, and thus enable the examiner to rm an opinion as to the age and sex of the individual. (*Vide* Identity.)

Period of the Occurrence of Death.—Death may take place, as pre-ously stated, within forty-eight hours after the person received the burn, or may be protracted for a period ranging from the second day to the fifth or xth week after the infliction of the injury. Since inflammation and suppu-tion do not generally commence before the third day, their presence would iow that the deceased had probably survived the injury two or more days. urther evidence might be presented by the state of advancement of these rocesses. Furthermore, the presence of inflammations and ulcerations of ie intestinal tract would also furnish some evidence as to the probable lapse f time.

The question, *How long after the reception of the burn did the person ive?* may arise in certain cases.

Wounds upon the Burned.—The importance of examining the body lead by fire for wounds cannot be overlooked, as post-mortem burning of a body is often resorted to, as already indicated, by a murderer with a view of avoiding detection. Ante-mortem wounds (*vide* Causes of Death from Burns, p. 342) are often produced upon the body in the case of burning buildings, etc. Other injuries received before death as the result of mechanical effects by fires, as fissures in the thorax and abdomen, or in the region of the large joints, are frequently mistaken for wounds inflicted by an assailant. The rregularity in form of these fissures and the usually intact condition of the lood-vessels are evidences against the opening being a real wound, and re rather indicative that it was produced by excessive heat.

The bones of the dead person may appear somewhat split or cracked on count of this heat, and they may sometimes crumble to pieces. When a rpse is completely charred by fire it is impossible to distinguish incised, nctured, or contused wounds upon it.

Was the death by burning accidental, suicidal, homicidal, or was it the sult of spontaneous combustion? Death by burning is almost always due accident, and such cases are of frequent occurrence. Homicidal cases are ry rare, while suicide by burning is exceptional. The medical examiner ould make note of the position of the body of the deceased, and also its lation to the probable source of the fire. In such cases, where death is used by accident, the fatal result usually occurs, not at a spot near the fire, ut at some distance away, in consequence of the removal of the injured indi-

vidual, but in many instances death may occur at the place where the fire originated. This latter fact may suggest accidental death, although it does not positively exclude murder. It is important, therefore, to make a careful examination of the body or its parts and clothing burned for marks of violence, and the fact must not be overlooked that these marks, with the exception of fractures, may be impossible of recognition, or that they may have been purposely effaced by burning for the purpose of destroying the traces of crime.

If wounds are found upon the burned body, the question may present itself, *Were the wounds or the fire the cause of death?* And, furthermore, another question might arise in this connection,—*i.e.*, *Were the wounds found upon the body burned produced by violence, or were they the result of the fire?* The answers to these questions must be determined by the attending circumstances of individual cases. As regards the question of *spontaneous combustion* of the human body, Reese[1] states "that on close investigation it will be found that some source of fire had invariably been present, from which the combustion took its origin,—such as a lighted pipe or candle,—and that the body was that of an habitual spirit-drinker, and nearly always that of a very fat woman, conditions highly favorable for the process of combustion, *when once originated.* From the known composition of the human body, nearly seventy-five per cent. being water, it would seem to be chemically and physiologically impossible even to burn up a dead body, except on the application of an extraordinary degree of heat and for a continued length of time, such as is required by the process of cremation. Certainly the weight of authority is against the belief in spontaneous combustion of the human body; no person of position or authority has ever witnessed such a phenomenon, and we must therefore express our disbelief in it, and assign the wonderful accounts which from time to time have appeared in the newspapers and books to the region of romance and fiction. It is, of course, an admitted fact that various *organic* and *mineral* substances undergo spontaneous combustion through the agency of absorbed oxygen, especially when exposed to the action of the air in a state of fine powder or extended surface, as in flour-mills and other places where much fine dust is evolved. Conflagrations of large buildings have frequently thus originated, involving important legal questions as to incendiarism and to fire insurance." Tidy[2] reviews the subject of spontaneous combustion of the human body in the following language. "There is no subject in the whole range of medical jurisprudence on which so much romance has been built as this. Since 1692, when the subject was first seriously discussed, popular novelists have often embellished their works by the introduction of some such story, or amused themselves by telling or retelling some of the current legends on the subject. The disappearance of the law-writer in Dickens's "Bleak House" is perhaps one of the best of them. Writers on medical jurisprudence have

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[1] Medical Jurisprudence. [2] Legal Medicine.

ated the matter from different points of view. Some, like Beck, scarcely press any opinion on the subject. Others, like Casper, contemptuously ect it. Others again, as Taylor, combat the theory of spontaneous comstion in a more scientific spirit. On a careful consideration of the whole estion, we have come to the conclusion that there is no authentic case of le 'spontaneous' combustion of the human body on record."

The time required for the burning of a dead body does not admit of any finite answer, although in some cases, where the dead body has been rned to conceal murder, this question may be of importance. Casper[1] ates that a period of less than ten hours has been sufficient to cremate the uman body. (*Vide* Death from Lightning and Electricity, etc.)

CHAPTER XXIX.

VIOLENT DEATH FROM VARIOUS FORMS OF APNŒA (ASPHYXIA).

General Remarks — Suffocation — Causes — Symptoms — Treatment — Post-Mortem Signs—Evidence of Death by Suffocation—Accidental, Homicidal, and Suicidal Suffocation—Asphyxia from Charcoal Vapors—Asphyxia from Illuminating and Natural Gases—Asphyxia from Privies and Cesspools—*Strangulation—Hanging —Drowning*.

Apnœa or **Asphyxia**, death from obstruction to the lungs, is occasioned by the complete arrest of the functions of the respiratory organs and the consequent deprivation of atmospheric air from the lungs. Suffocation, strangulation, hanging, and drowning are included under this heading, but their individual properties will be subsequently considered. The causes, symptoms, and post-mortem appearances of the various modes of violent death have already been briefly alluded to, although the more important details will have to be separately considered. (*Vide* Strangulation, Suffocaon, Hanging, etc.)

The deprivation of atmospheric air from the lungs causes death by phyxia or apnœa. This is accomplished by mechanical interference to spiration, as by pressure upon the throat or thorax, as in throttling; by nging and strangling; by drowning; by the presence of foreign bodies in le larynx and trachea, as in choking; by injury to the walls of the chest, r by pressure upon the chest in large assemblages of people;[2] by being uried in sand-pits, hay, snow-banks, etc.; by certain diseases of the hroat, as obstruction of the larynx in diphtheria, œdema and spasm of the

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[1] Forensic Medicine.

[2] The Brooklyn bridge *crush* on opening day, May 24, 1883. The writer transorted many of the injured persons to St. Vincent's Hospital for treatment.

glottis, membranous croup, ètc.; or by the inhalation of poisonous gases. All of these obstructions act by interfering and arresting the functions of the organs of respiration.

The *symptoms* which indicate death by apnœa are lividity of the lips and of the various extremities of the body. Generally the whole face is livid and swollen. The struggle to breathe is intense, and the movements of the arms and legs are at first partly voluntary, soon to be followed by spasmodic and involuntary struggles. The veins become turgid; the pulse, which is at first rapid and full, soon becomes feeble and scarcely discernible, and there is very often frothing at the mouth, which is occasionally tinged with blood from injury to the tongue. The genital organs are frequently turgid and the sphincters relaxed, causing involuntary discharges of urine, fæces, and semen. The feeble attempts at breathing are soon succeeded by the complete cessation of the action of the heart.

Loss of consciousness takes place very soon, although in the early stages the senses are very active. (It is well to recollect that the difficulty of breathing in apnœa precedes unconsciousness, while in *coma* the embarrassed respiratory powers succeed the loss of consciousness.)

There is a great similarity of the *post-mortem signs* in all varieties of death from apnœa. The face and various other parts of the body are livid, but in the case of drowning the general appearance of the face is more likely to be pale, a state which is also frequently observed in the case of hanging. The venous system is usually engorged with blood. The pulmonary artery and the right side of the heart, together with the lungs, are usually full of blood, which is of a dark color, while the left side of the heart, the aorta, and the pulmonary veins are comparatively empty. Congestion of the mucous membrane of the bronchial tubes and of the membranes and substance of the lungs and brain usually exists. The pleura, pericardium, endocardium, peritoneum, etc., are ecchymotic, while the veins and sinuses of the brain are often turgid with blood. Congestion of the liver, spleen, brain, and kidneys usually exists. The blood-vessels of the lungs in the young may be found empty, and the emphysematous condition of the lungs, often present in such cases, is occasioned by the futile efforts made to breathe.

The blood, as a rule, is fluid and dark in color, with the exception of those cases of suffocation due to carbonic oxide, where it is of a bright red color.

SUFFOCATION.

Causes.—*Suffocation*, properly speaking, applies to every variety of death resulting from an arrest of the functions of respiration; but as it will be considered here, we are to understand its application in a special sense,—viz., to the act and condition of preventing the entrance of atmospheric air (oxygen) into the lungs in ways other than by strangulation, hanging, drowning, etc. By *smothering* is meant the act and effect of preventing the free ingress and egress of air by stopping the mouth and nose.

The lungs are deprived of air in one of two ways,—viz., (1) me- unically or (2) dynamically. The first method of interference has eady been alluded to (p. 345), while the second cause has been but ited at. This class includes the inhalation of poisonous gases, thus priving the blood of the influence of oxygen. (*Vide* Accidental Suffo- tion.)

Symptoms.—These are hyperpnœa, with frequent and labored respira- ns, to be soon followed by dyspnœa. The violent efforts at breathing are oduced by the circulation of venous blood in the medulla oblongata, thereby imulating the centre of respiration. This stage lasts for a very brief space time,—about one minute,—when the convulsive stage supervenes. Here e activity of the muscles of inspiration is lessened, while that of the ex- ratory muscles is considerably increased, causing violent agitation and nvulsion of the entire muscular system. This state is due to the stimula- on of the centre of respiration by the venous blood. This stage is of ort duration, being followed by the stage of exhaustion, by which the spiratory centres are destroyed (paralyzed) through the influence of the rculation of the venous blood. Consciousness is lost very early, and the upils are considerably dilated, the muscles being flaccid, while the reflex cts are entirely abolished. Abortive attempts at breathing are the only gns of life, and these gradually cease altogether. The complete cessation f the powers of respiration is finally preceded by the rigid contraction or xtension of the extremities and other parts of the body, due to the circula- ion of the venous blood in the spinal cord. The stage of exhaustion is ucceeded by paralysis of the heart, extremely feeble pulse, and entire ces- ation of the action of the heart a few seconds after the final suspension of he respiratory powers. Three to five minutes are sufficient to include the whole series of phenomena just depicted. Of the three stages presented, he last (third, or stage of exhaustion) is the longest. Auscultation, if a for- eign body in the trachea has gravitated toward the right bronchus, will elicit igns on the right side; whereas, if the trouble be referable to the larynx or rachea, both sides will be affected. Here auscultation would elicit reso- nance over the lung with the partial or complete absence of the respiratory murmur. This condition is not always dangerous, particularly if the foreign body does not interfere with the ingress of the atmospheric air. If the onverse prevails, then the danger is great, for more or less dyspnœa is ap- arent. Convulsions, apoplexy, etc., may rapidly follow as a result of the reat diminution in the supply of the necessary amount of air (oxygen) to aintain life. The presence of a foreign body in the air-passages is always anifest by its local effect upon the tissues involved. Thus, an irritation is ways likely to follow and be succeeded by spasm and cough. Forcible stention of that part of the lung not affected by the presence of the reign body is likely to be followed by emphysema. Irritation of the part fected is almost always followed by inflammation, although, if the disturb- ice does not entirely interfere with the powers of respiration, recovery may

be hoped for. The fact must not, however, be forgotten that death may follow as a result of secondary effects.

Treatment.—This is always, of course, dependent upon the cause which operates, and resolves itself into the detection and removal of the obstruction preventing the access of air into the lungs. (*Vide* surgical works for the proper means and methods of treatment.)

Post-Mortem Signs.—These are, as a rule, well defined. The medical examiner must be extremely careful to note whether evidences of external violence, accidental or homicidal, exist. The post-mortem appearances are mostly those of asphyxia. The skin and conjunctiva are usually dotted with patches of lividity and ecchymoses. The lips and the extremities of the body are livid, but the countenance may be pale or even violet, while it is often placid,—a mark of accidental suffocation. According to Tardieu, the lividity and ecchymoses of the conjunctiva are frequently observed in women who have suffered a severe labor. The same authority refers to similar signs in epileptics. Congestion of the eyes usually exists in these cases of suffocation, and the nose and mouth are often surrounded by mucus and froth mixed with blood. Protrusion of the tongue may or may not exist. The blood is mostly fluid and dark-colored, and its flow from wounds after death is not uncommon. The right side of the heart, the pulmonary artery, the vena cava, and the cervical veins are more or less engorged with blood. The heart, however, is occasionally found to be empty. The track of the coronary vessels may show ecchymotic spots; and, according to Lamb,[1] "the blood in the heart may be partly coagulated if the agony has been prolonged and there has been a partial access of air, which is gradually diminished." The same authority quotes Mackenzie as stating that the right cavities of the heart are found to be full and the left cavities empty in nine cases out of thirteen. Black fluid blood is generally found in the kidneys, brain, liver, and the walls of the intestines. The tracheal mucosa is usually of a bright red color, often covered with bloody froth. The mucosa of the larynx is injected, and the lungs are full of dark fluid blood. Foreign bodies may be discovered in either the larynx, trachea, pharynx, or œsophagus. The condition of the spleen may be that of anæmia. Semen is sometimes found in the urethral canal.

As the above post-mortem appearances are found to exist in other forms of death by asphyxia, they cannot be considered as characteristic of the form of death by suffocation. Extreme care should, therefore, be taken by the medical examiner in expressing an opinion as to the real cause of death. A question of importance that is likely to arise in these cases is, if a body be found in earth, ashes, snow, etc., Was it so placed before or after death? Careful examination is the only method for the medical examiner to follow in order to frame a correct decision.

Evidence of Death by Suffocation.—This is extremely difficult to as-

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

rtain, since there are no lesions upon which to base a positive opinion. A omewhat definite conclusion might be reached by bringing together and omparing the existing lesions with the surroundings of the dead body. Taylor[1] states that "the inspection of the body of a person suffocated pre-ents so little that is peculiar that a medical man, unless his suspicions were roused by circumstantial evidence, or by the discovery of foreign substances n the air-passages, would probably pass it over as a case of death without any assignable cause; in other words, from natural causes. . . . Appear-ances similar to those found in the bodies of suffocated persons are very fre-quently met with in post-mortem inspections when death has taken place as a consequence of disease or accident. They can, therefore, furnish no positive evidence of the kind of death; they do not even permit us to establish a presumption on the subject, until, by a careful examination of the body, we have ascertained that there is no other cause of death depending on organic disease or on violence. Medical evidence may, however, be highly service-able in some instances. Thus, let the general evidence establish that a deceased person has been probably suffocated: the witness may have it in his power to state that the appearances in the body are not opposed to the supposition of this kind of death; that the body is in all respects healthy and sound; and that the death was probably sudden, as where, for instance, undigested food is discovered in the stomach." Tardieu is quoted by Lamb[2] as holding "that when in infants buried in pulverulent substances we find emphysema of the lungs in high degree, bloody froth in the air-passages, abundant subpleural and subpericardial ecchymoses, and the blood fluid, the burial has occurred during life."

The following statement is quoted from Lamb's article on "Suffocation."[3] "The Committee on Suffocation of the New York Medico-Legal Society reported the following group of appearances as evidences of death by suffoca-tion: the general venous character of the blood; the turgidity of the larger veins; the congestion of the parenchymatous organs, especially at the base of the brain; the lungs congested in a variable degree; and œdematous, frothy mucus in the bronchi; the right side of the heart always fuller than the left. Fitz holds that suffocation is a condition composed of a group of symptoms and appearances due most probably to accumulation of carbon dioxide in the blood and a deficiency of oxygen. The appearances are: the blood dark and fluid (though in gradual suffocation there may be clots in the right side of the heart); the right side of the heart full; venous con-gestion of the lungs (not constant); interstitial emphysema of the lungs; and venous congestion of the liver, kidneys, and brain. He prefers the word engorgement to congestion in this connection."

Accidental, Homicidal, and Suicidal Suffocation.—Accidental suf-focation is of common occurrence; homicidal suffocation is by no means of rare occurrence; while suicidal suffocation is of rare occurrence.

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[1] Medical Jurisprudence. [2] Op. cit. [3] Op. cit.

Suffocation may be due to a variety of accidents. Thus, as has already been intimated (*vide* p. 345), a person may die suffocated from the obstruction to respiration caused by disease about the tongue, larynx, or fauces; or persons helpless or in a state of intoxication or debility may be accidentally suffocated by the mouth and nose being covered over, or the throat compressed in such a way externally as to interfere with the proper oxygenation of the blood. Other causes of accidental suffocation are the fixation of a portion of food, such as meat, in the larynx or fauces; or, in the case of young children and infants, the mechanical compression of the chest or throat, as where they are too closely wrapped up, pressed too tightly to the mother's breast, or overlaid by one or both parents while asleep. Children, old and feeble persons, intoxicated and epileptic individuals, have perished by falling into ashes, mud, snow-drifts, feathers, etc., in such a way that the mouth and nose became covered with one of the substances mentioned, death easily taking place in a very short space of time. Great pressure on the thorax, as occurs in large assemblages of people, has caused death by suffocation, as also the accidental passage into the larynx of small bodies, such as screws, the fang of a tooth, grains of corn, marbles, peas, buttons, fruit-stones, shot, etc., from the mouth, especially in young children. Cases are mentioned where artificial teeth have slipped into the air-passages from the mouth during the administration of an anæsthetic, and similar results have followed during an epileptic or puerperal convulsion. Suffocation may also be the cause of death on account of the passage of blood, during hemorrhage from the lungs, into the air-passages. Death beginning at the lungs may also be due to the inaction of the respiratory muscles, a result brought about by muscular exhaustion (debility, etc.), loss of nerve-power, tonic spasm, etc. Paralysis of the muscles of deglutition, due to diphtheria, etc., predisposes to suffocation. Lamb[1] states that "the taking of plaster casts of the face and neck without inserting tubes in the nostrils has caused death in some cases. . . . It is not necessary that the air-passages should be *absolutely* closed to cause suffocation."

"Those instances of accidental suffocation which depend on disease or on the impaction of food," says Taylor,[2] "are easily known by a post-mortem examination; generally speaking, they present no difficulty. But in other instances—*e.g.*, when a child or drunken person is presumed to have been suffocated owing to the position in which he had fallen—evidence as to the position of the body, or even the actual sight of the body, is necessary before forming an opinion. The following questions may here arise. Was the position such as to be explicable on the supposition of accident? Was it not such a position as might have been given to it by a murderer? Could not the deceased have had strength or presence of mind to escape? Could he have actually suffocated in the position in which his body was discovered? A little reflection upon the circumstances—for here something more than

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[1] Op. cit. [2] Op. cit.

dical circumstances will be required—may enable us to give satisfactory swers to these questions."

Homicidal suffocation may be considered as presumptive evidence unless e facts of the case are already referable to accident. (Taylor). It is usually actised upon infants, children, the feeble or debilitated, or on those who nnot assist themselves,—in other words, those who are absolutely helpless. ew-born children are easily killed by this means. (*Vide* Infanticide.) The ethod of destroying life as adopted by Burke and Williams, the notorious urderers, of Edinburgh, was by pressure on the chest with their whole eight, and at the same time forcible closure of mouth and nostrils. Little-ohn describes a curious case of homicidal suffocation, where a woman, over xty years of age, was discovered dead, with a wound upon the scalp, em-hysema in the chest, and seven ribs broken. The face was pale and com-osed, the eyes closed, and the tongue protruding. The cork of a quart ottle was found tightly wedged in the larynx, the sealed end being upper-ost. The epiglottis, trachea, and larynx were somewhat injected. During e trial the attempt was made to prove that the woman had pulled the cork om the bottle with her teeth, and that it was suddenly drawn into her indpipe during her intoxicated state; but the fact that the sealed end of e cork was uppermost, and that the marks of the corkscrew were plainly isible, showed that it was forcibly inserted into the windpipe while the oman was unable to make resistance on account of her intemperate con-ition.

Suicidal suffocation, as already stated, is extremely rare, for, as Taylor tates, "it would require a peculiar adaptation of means and considerable esolution in order that a person should thus destroy himself." Still, how-ever, some remarkable cases are recorded. Sankey[1] mentions the case of an epileptic who destroyed himself by forcing a round pebble in each nostril, and stuffing a strip of flannel, rolled up, into his throat. In another case of desperate suicide, that of a woman, death followed suffocation caused by forcing down the throat into the pharynx, behind the larynx, a ball of hay, which became visible on separation of the jaws.[2] These are examples of uicidal suffocation.

Asphyxia from Charcoal Vapors.[3]—The gas evolved during the

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[1] British Medical Journal, 1883, vol. i. p. 88.

[2] Year-Book of Medicine and Surgery, p. 458.

[3] "The term 'dynamical asphyxia' is used by Casper to denote those cases in hich death is brought about by the respired air, charged with some noxious gas, cting directly on the lungs. Death may occur by this means in three ways. First, he gas may cause spasm of the glottis, or by entering the larynx cause inflammation, welling, and occlusion of the tubes. This may properly be called a mechanical ause, but is best considered under the second heading of dynamical causes of as-hyxia, as the action may be twofold. Such gases are the pungent vapors of hydro-hloric, nitric, nitrous, sulphurous, or other acids. The post-mortem signs would be hose of asphyxia. Second, the gas may destroy life by acting in the blood, either by displacing oxygen, such as carbonic oxide (CO) and hydrocyanic acid (HCN), or by

combustion of charcoal consists chiefly of carbonic acid and carbonic oxide. If the activity of the combustion be very great, the proportion of the former gas over the latter will be somewhat in excess; but if the combustion be imperfect, the carbonic oxide gas will increase in quantity. When charcoal burns in the open air it produces about one-half per cent. of carbonic oxide. Man could hardly survive exposure to an atmosphere containing five per cent. of carbonic acid and one-half per cent. of carbonic oxide, although this mixture will support the combustion of a candle. (Reese.)

In the United States suicides by resort to the vapor of charcoal are rare, but in France self-destruction by this means is quite common.

The *symptoms* of asphyxia from this gas are headache, with a sense of pressure about the temples, vertigo, tinnitis aurium, with a tendency to sleep. Muscular power is completely lost, vision is disturbed, and the pulse is rapid and feeble. The efforts at respiration are difficult and stertorous, and complete insensibility ensues, often preceded by vomiting. Convulsions occasionally precede coma and death. Fatal results usually follow in from one to two hours after exposure to the vapor. Death may take place even when the poisonous gas is diluted with atmospheric air.

The *post-mortem appearances* are subject to variation. Occasionally the countenance presents an injected appearance, the eyes being bright and staring, while the limbs are frequently supple. On the other hand, the face is pale, as well as the entire skin-surface, and the muscles are in a state of complete rigidity, a condition appearing soon after death and disappearing in a few hours. Again, the countenance may appear as if bloated. Lutaud states that the more or less pronounced presence of large rose-colored spots on the thighs, chest, and abdomen is a very characteristic sign, since they are found to be absent in other varieties of asphyxia. They are very lasting, and may remain even after the process of putrefaction has commenced. The brain may be found more or less in a state of congestion. Bernard states that the fluidity and bright redness of the blood—important signs—are occasioned by the stronger affinity of the hæmoglobin of the blood-corpuscles for carbonic oxide than for oxygen. They, therefore, from the very beginning, assume the arterial tint, and retain it throughout the venous circulation. (Reese.) The spectrum of such blood closely resembles that furnished by arterial blood, and, according to Reese,[1] resort to the micro-spectroscope should be encouraged in all cases of fatal charcoal-vapor poisoning, since the existence of carbonic oxide in the blood may be demonstrated thereby.

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reducing the hæmoglobin and robbing the corpuscles of oxygen, as in the case of sulphuretted hydrogen (H_2S), where sulphur (S) and water (H_2O) are formed. Third, the cases in which the air is wanting in, or has been deprived of, the oxygen sufficient for continued life, as, for instance, in vitiated atmosphere, when the carbonic acid (CO) is increased in quantity either by over-production or by the oxygen being gradually used up, ten per cent. of CO in atmospheric air endangering life."

[1] Op. cit.

The apoplectic nodules in the lungs and the subpleural ecchymoses of strangulation and suffocation are not constant post-mortem signs in asphyxia due to charcoal vapor. The right cavities of the heart, the lungs, and the large veins are usually engorged with venous blood. Occasionally there is serous effusion of the brain. It is well to remember that for the purpose of diverting suspicion of homicide the body of a murdered person may have been so disposed by an assassin as to simulate asphyxia from charcoal vapor. (Reese.)

The *treatment* consists in the removal of the patient to the open air, while the body is thoroughly affused with cold water. Stimulating applications to the chest and extremities are indicated. Venesection is sometimes resorted to if the face is bloated. Other means for resuscitation are artificial respiration, galvanism, and the inhalation of pure oxygen gas.

Asphyxia from Illuminating and Natural Gases.—*Illuminating gas* is a very active asphyxiant. It owes its poisonous qualities to carbonic oxide, carburetted hydrogen, carbonic acid, and occasionally sulphurous acid and sulphuretted hydrogen. An atmosphere containing one-eleventh part of this gas explodes if it comes in contact with flame. A much less proportion, however, than this amount will render the atmospheric air incapable of supporting life. (Reese.)

The *symptoms* produced by this gas, when combined with air and breathed, are those of asphyxia. There are headache, confusion of the intellect, vertigo, and nausea and vomiting. The patient soon loses consciousness, and becomes insensible and completely prostrated. Convulsions usually precede death.

As in the asphyxia due to charcoal vapor, the *post-mortem signs* vary somewhat. The brain is usually in a state of congestion, and there is more or less serous effusion. The blood is coagulated and of a dark color, while the respiratory organs are engorged with mucus tinged with blood, and injected. Again, the brain may be pale, with serous effusion, and the blood liquid and of a brightish hue. The rose-colored spots observed by Lutaud in the asphyxia occasioned by the fumes of charcoal are present here also.

An interesting case showing the poisonous effects of this gas recently occurred in Brooklyn, New York. A despondent father, bent on suicide and murder, destroyed the lives of his two children, aged six and two and a half years respectively, by placing them in a box and suffocating them with illuminating gas. After having disposed of the children, he ended his own misery by sending a bullet through his right temple. The box used was about four feet square at its base and about three feet high. A rubber tube, which was connected with the gas-jet above it, entered a hole at the side of the box. The two children were found as if asleep, and the box was densely filled with the gas. It is surmised that the father placed the victims in the death-trap after they had fallen asleep, for it was not such a place as small children would have chosen in which to play or sleep. The little children probably lay down on the sofa and fell asleep. Then their father must have

placed them gently side by side on the floor of the box and closed the lid. The narrow confines of the place must have speedily filled with gas, and it likely that the victims died without ever recovering consciousness.

Water-gas, which contains a greater amount of carbonic oxide than illuminating gas, is very fatal in its effects if inhaled; and, as it possesses no odor, its dangerous qualities are vastly increased. It is a variety of illuminating gas.

Natural illuminating gas varies in its composition as follows. "The amount of carbonic oxide may vary from 0.1 to 1 per cent.; carbonic acid from 0 to 0.8; marsh gas from 50 to 75; hydrogen from 9 to 36, etc." (Reese.) Natural gas is odorless. Its power of producing heat is great, and it is largely employed in oil countries as an illuminant and heat producer.

Sulphuretted hydrogen may prove instantly fatal when inhaled pure. It is, however, usually in a state of dilution in those cases of asphyxiation with which the legal physician has to do. Fortunately, the offensive odor of sulphuretted hydrogen serves as a warning of its dangerous qualities. It usually exists in combination with other gases, resulting from the decay of animal matter. When breathed in its diluted state, it causes speedy insensibility and even death. The latter is doubtless due to the rapid destruction of the blood-corpuscles. The victims are usually workmen employed in drains, sewers, etc., or in an atmosphere mixed with the poisonous gas. These individuals usually complain of giddiness, nausea, and weakness. Death is preceded, in acute cases, in addition to giddiness, etc., by loss of strength, paralysis, convulsions, coma, and insensibility. Occasionally there is tetanus with delirium. Respiration is always labored, and the skin is cold and the pulse rapid and feeble. The treatment is negative, unless the patient can be hurriedly removed to the open air, and stimulants, etc., administered. Chlorine gas, diluted, may be of service. Post mortem, the face may assume a greenish-yellow tint, or it may be pale and the lips anæmic. The consistence of the brain may be firm, but anæmia usually exists; and the cortical substance presents a dirty grayish color, while the choroid plexuses are pale or livid. The lungs are frequently hyperæmic and of a blackish hue, due, no doubt, to the decomposition of the hæmoglobin of the red blood-corpuscles. The air-passages may contain froth, and the mucous membranes of the larynx and trachea are sometimes of a dark-brown or crimson color. The right ventricle of the heart usually contains a few drops of blood, while the left side is entirely empty. The organ itself is in a state of collapse, but in some instances it may be engorged with blood. The dark-brown or black color of the blood, as already intimated, is due to the destruction of the blood-corpuscles. The variation that frequently occurs in the post-mortem appearances of asphyxiation by sulphuretted hydrogen is due to the difference in time of the occurrence of death. Greater congestion takes place when the death is protracted.

Sulphurous acid gas is one of the products of the combustion of ordinary coal. It is colorless, and possesses a pungent, suffocating odor. Among

its principal properties are those of bleaching and deodorizing; it also acts as an antiseptic, and when sufficiently concentrated is probably a germicide. In medicine it is employed in an aqueous solution, the proportion of gas being about 3.5 per cent.

Nitrous acid gas, when breathed, acts as a very violent poison, producing inflammation of the air-passages and lungs. As given off by nitric acid, it has proved fatal in several instances.

Hydrochloric acid gas, when in its concentrated state, is irrespirable, but, when diluted, it causes intense irritation of the air-passages and lungs.

Asphyxia from Privies and Cesspools.—The *poisonous vapors* emanating from *privy vaults* are due to ammonium sulphide, sulphuretted hydrogen, and nitrogen. The *symptoms* are as follows: fulness in the head, headache with a sense of constriction about the temples, vertigo, nausea, muscular weakness, and loss of consciousness. Lividity of the face and an escape of bloody froth from the mouth are usually observed. The pupils are immovable and dilated, and the surface of the body and the extremities are cold and clammy. Death is usually preceded by convulsions and coma. In examining these cases the expert should endeavor to separate the poisonous agent (sulphuretted hydrogen) from the blood.

The noxious vapors from *cesspools* are produced by sulphuretted hydrogen, carbonic acid, and nitrogen. The symptoms are very similar to those just mentioned under asphyxia from privies. Taylor[1] mentions the case of a man who was asphyxiated by the escape of a large amount of sulphuretted hydrogen from a foul drain. Previous to the accident a quantity of sulphuric acid (oil of vitriol) had been emptied into the drain, which communicated with a privy. The deceased appeared shortly afterwards and entered the yard, where he was soon found in a dying condition. The physician who examined the body found the brain normal, but the lungs were engorged with blood, which evolved the characteristic odor of sulphuretted hydrogen gas. To this gas was ascribed the death.

In addition to these causes of asphyxia there are other noxious gases chiefly due to artificial products, and the reader is referred to other works for their thorough consideration.

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[1] Op. cit.

CHAPTER XXX.

STRANGULATION.

Modes of Strangulation — Symptoms — Treatment — Post-Mortem Signs — Proof of Death by Strangulation—Accidental, Suicidal, and Homicidal Strangulation—*Hanging—Drowning*.

Strangulation is produced by constriction of the throat by means of an encircling cord, or by the application of pressure made by the fingers or otherwise. The means by which strangulation is produced are many. Thus, among the great variety of ligatures employed might be mentioned the following: ropes, leather straps, collars, lassos, ribbons, bonnet-strings, twigs, net-strings, girdles, fishing-nets, bamboos, hair, strips torn from sheets or clothing, etc. Various hard substances, like stones, sticks of wood, coal, etc., are often used to increase the pressure of the ligature.

The *garrote*, the mode of execution in Spain and Italy, is a steel collar which is tightened on the neck by a screw, the victim being securely tied to a pillar or post. In Turkey and other Eastern countries, the usual mode of executing criminals is by suffocating them by means of the bowstring. In the United States and England the word garroting is used to signify the forcible compression of the throat (trachea) by thieves. The victim is usually attacked from behind, the robbery occurring during the assault.

In hanging, the phenomena of suffocation take place as a result of the pressure upon the neck due to the weight of the body itself. The direction of the ligature around the neck also serves to distinguish between strangulation and hanging. In strangulation the encircling cord is placed horizontally, while in hanging it has an oblique direction. Medico-legally the differences that exist between death from strangulation and death from hanging are of great importance, as the former is almost always homicidal, while the latter is almost always suicidal. The cause of death in most instances seems to be deprivation of atmospheric air and pressure upon the jugular veins, producing apnœa and congestion of the brain respectively. According to Reese,[1] the sudden and violent constriction of the throat by means of the hand will occasion unconsciousness much more speedily than if the constriction be made by an encircling cord or band. The rapidity with which fatal results follow strangulation depends, to a certain extent, on the amount of force employed and on the completeness of the obstruction to the respiratory apparatus. The force generally employed in strangling is greater than is necessary to produce asphyxia; hence the

[1] Op. cit.

marks on the skin of the neck are usually more distinct than those resulting from hanging.

Symptoms.—These are usually very distinctly marked. The face is usually livid and swollen; but occasionally, when the arrest of the atmospheric air is complete, it becomes entirely black in color. The pupils are dilated and the eyes assume a staring appearance. The tongue protrudes and may appear wounded. The extremities are livid and the genital organs often turgid. Occasionally there has been noted hemorrhage from the ears, nose, mouth, and throat. The face, neck, eyes, and chest may appear ecchymotic. There may be involuntary escape of urine and fæces, as in death by hanging. As a rule, the hands are clinched, and insensibility is so speedy that pain is entirely abolished. Convulsive movements may occur when the closure is incomplete.

The symptoms, as outlined by Lamb,[1] are divided into four stages, as follows. The *first*, or *preliminary*, *stage* lasts for a variable period of time, according as the strangulation is immediate or not. "In a case of homicide, injuries may be inflicted on the victim in this stage which may have an important bearing on the cause of death. Blows on the head may cause unconsciousness or even apoplexy; upon the stomach may cause syncope; stab-wounds may tend to cause death from hemorrhage." The *second stage* manifests itself by a demand for atmospheric air. It lasts until the signs of insensibility appear. During this stage the patient makes desperate efforts to respire. The expression of the face may be intense if the patient be still in possession of his faculties and is conscious. There may be protrusion of the eyeballs, clinching of the hands, and an unusual mental activity. The tongue may protrude and be bitten, and there may be, as noted above, an escape of urine, fæces, and semen. The supervention of the *third stage* is speedy. It is characterized by insensibility and spasms. There may be opisthotonos, turgidity of the veins, and bleeding from the eyes, nostrils, mouth, etc. Hemorrhage into the connective tissues of the lungs, pleura, etc., sometimes occurs during the third stage. The surface of the body is usually livid, due to the circulation of venous blood in the arteries. This lividity is especially noticeable where the skin is thin. During the *fourth*, or *last*, *stage* all irregular, involuntary movements (spasms) and efforts to breathe cease, and the sufferer remains in a perfectly quiet state, butthe pulsation of the heart may be evident. This stage ceases with the stoppage of the action of the heart.

Death from strangulation will be immediate or not according as the means employed to arrest the supply of atmospheric air to the respiratory apparatus blocks the access of air completely or only partially. According to Eaure's experiments on animals, a dog perished in three and one-half minutes when the constriction was sudden and complete. In another instance death was delayed for some time owing to the imperfectness of the

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[1] Op. cit.

closure. From the writings of Taylor, Tidy, and others, we are led to believe that death takes place sooner in man than in animals, and in some cases it may be immediate. The secondary effects of strangulation—paralysis, aphonia, abscesses, swelling of the face, neck, and chest, convulsions, etc.—are occasionally the remote cause of death, as where the patient recovered from the immediate effects of strangulation.

The following account of Dr. Graeme H. Hammond's personal experiment in strangulation is quoted from Lamb.[1] "He sat down; a towel was passed around his neck and the ends twisted together, making forcible compression of the neck. At first he had a feeling of warmth and tingling, first in the feet, then passing over the entire body; vision partly lost; his head felt as if it would burst; there was confused roaring in the ears, like the sound heard on placing to the ear a shell; he remained conscious. In one minute and twenty seconds all sensibility was abolished. After a few minutes' rest a second similar trial was made, with similar results, except that sensibility was lost in fifty-five seconds. A stab with a knife drawing the blood caused no sensation."

Treatment.—The first indication is to remove the mechanical cause of the obstruction to the free access of air to the lungs. Articles of clothing which might interfere with the normal movements of the chest must be removed at once. The movements of respiration should be immediately imitated so as to arterialize the venous blood. Artificial respiration may be greatly aided by the application of ammonia to the nostrils, tickling the fauces with a feather, etc., and by the application of the galvanic current. Artificial respiration is useless if the mechanical cause has produced other injury than mere strangulation; and, according to Colin, its value is lost after the arrest of the pulsation of the heart. The use of artificial heat applied to the body and extremities is of great value when the body is cold. This may be applied in the form of hot bottles, hot bricks, hot-water bags, etc. In some cases venesection may be necessary, especially where there is distention of the heart. It is hardly necessary to refer to the value of using stimulants, light food, etc., in these cases. Oxygen and ether have been administered hypodermatically. The subsequent treatment will depend entirely on the after-conditions.

Post-Mortem Signs.—These are both external and internal. The face and extremities are usually of a violet, dark-red, or black color, and considerably swollen; but, according to Casper, the appearance of the face is the same as that of any other dead body. Tidy[2] says that in the cases coming under his notice there was a general lividity of the entire body. In fourteen cases observed by Liman[3] there was only one in which he found lividity of the face. Minute ecchymoses are frequently observed on the skin of the face, neck, etc. This is by no means a characteristic sign, as has been observed in cases of death from other causes, such as in asphyx

[1] Op. cit. [2] Op. cit. [3] Annales d'Hygiène, 1867.

due to compression of the chest and abdomen, etc. Liman[1] observes that he found ecchymoses in those who died from strangulation due to hanging. Lamb[2] quotes Liman as stating that he found cyanosis in the conjunctivæ, lips, back of the mouth, and in the muscles, and Maschka as stating that out of two hundred and thirty-four cases of asphyxia he discovered capillary hemorrhages of the eyelids and eyes in eighty-seven cases. The hypostases in strangulation are darker in color than those found in other forms of death, and they usually make their appearance speedily on account of the fluidity of the blood.

Hemorrhage from the nostrils, mouth, eyes, and ears may be evident, although Chevers states that he has never observed bleeding from the ears. When it does occur, however, it probably results from rupture of the tympanum. Littré saw a case of rupture of the tympanum in strangulation produced by a cord around the neck, and Geoghegan mentions a case of strangulation by a ribbon with rupture of the tympanic membrane and hemorrhage.

The eyes are usually open, staring, and prominent. They may show signs of congestion and dilatation of the pupil. Lamb[3] states that "ophthalmoscopic examination during the dyspnœa of asphyxia shows a lessened fulness of the retinal vessels."

The tongue may be swollen, dark in color, bitten, and protruding between the teeth. Tidy[4] states that "the position of the tongue has been supposed to be dependent on the position of the ligature." According to Belloc, Fodéré, and Orfila, the same authority says, "if the ligature be above the hyoid bone, the tongue is not protruded, while if it be below the hyoid bone, it is. Fleischmann thinks that its position depends on whether death occurs during expiration or inspiration."

The hands in most cases are clinched. This state of the hands is observed in almost all cases of death by violence. The medical examiner should note whether they contain within their grasp articles which might have some medico-legal interest. All of the appearances just noted are much more prominent in strangulation than in hanging. The involuntary discharge of urine, fæces, and semen is not characteristic, and bears no especial importance, medico-legally considered.

The marks on the neck are usually much more evident in strangulation than in hanging, on account of the greater degree of violence employed. They are subject to considerable variation, according to their cause. Thus, the marks of manual pressure, if present, are usually found located in front of the neck, immediately above or below the larynx. The marks of the fingers or of the thumb, together with scratches, are commonly evident. In some cases of death by strangulation the marks usually seen may be very slight or entirely wanting. In suicide this is usually the case, while in homicidal strangulation the converse prevails; but it is important to

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[1] Op. cit. [2] Op. cit. [3] Op. cit. [4] Op. cit.

recollect that the deceased might have been stunned and then killed by strangling. The marks made on the body by strangulation are much more evident when the body is cold, and in cases of recovery from suicidal attempts.

The pressure of a hard substance on the neck, as of a stone wrapped in a handkerchief or other cloth, may produce a bruise of considerable size, corresponding somewhat to the shape and size of the body employed.

The mark of the ligature is usually well defined. It encircles the neck rather more than in hanging. The position of the ligature in both strangulation and hanging has already been given. (*Vide* p. 356.) The fact must not be overlooked, however, that in hanging the ligature may be horizontal, while in strangulation it may be oblique. Tidy[1] states that "as a rule, however, a horizontal mark of a cord, the knot being on the same level as the cord, more especially if it be a complete mark and below the larynx, suggests strangulation rather than suspension. There may be several marks, and this circumstance is always rather suggestive of strangling than of hanging." The mark of the cord usually corresponds to the breadth of the ligature. The depression made is rather shallow than deep, the skin at its bottom being very pale and in striking contrast to the neighboring parts, which are red or livid. Ecchymoses are occasionally observed at the bottom of the groove, as the conditions favoring their development are good in strangulation. Microscopic examination of the skin and connective tissue of the groove frequently shows hyperæmias and hemorrhages. Lamb[2] quotes Liman as saying that where suggillation in the groove or adjacent parts exists, some other form of violence has been applied in conjunction with that effected by the hand or cord. According to Bremme, no hemorrhage is to be found in the subcutaneous tissue of the ligature mark, either in strangulation or in hanging, if the effects are fatal immediately and the ligature is removed shortly after the death of the person. The converse prevails, and there may be hemorrhage, if death be protracted, no matter whether the constricting cord be removed or not.

Cases are on record where there were no marks apparent after this mode of death, but such cases are, of course, extremely rare. Tidy[3] says that "the riddle of strangulation without mark depends on the use of a soft, yielding ligature, suffocation being added to slight preliminary constriction of the throat."

The parchment-like skin observed in hanging is ot rare occurrence in strangulation.

The *internal appearances* of the mark of the cord or hands show hemorrhage into the loose connective tissue underlying the mark. There is also effusion of blood in the subjacent muscles. In most cases these effusions are isolated and circumscribed, but they may extend beyond the mark. Tardieu states that the effusion produced by the compression of the hand i

[1] Op. cit. [2] Op. cit. [3] Op. cit.

much more marked than that due to a ligature. Rupture of the internal and middle coats of the carotids is occasionally seen. This is especially the case in atheromatous subjects or in lean-necked individuals. Hemorrhage into these coats is, according to Friedberg,[1] proof that the strangulation occurred *ante-mortem*, and was probably the result of the pressure effected by the hand on the throat, irrespective of any diseased condition of the artery. The lining membranes of the larynx and trachea are usually in a state of congestion; they may appear livid and of a dark-red color. Bloody froth may also be seen extending to the air-tubes.

The neck, owing to the violence employed, may show great injury, although such a condition is not common. In some instances the neck is broken. Fracture of the hyoid bone may be apparent. The trachea is occasionally torn, and the cartilages of the larynx, if ossified, may show evidences of fracture. Extensive lesions of the larynx are observed in homicidal strangulation (throttling) where the force employed has been excessive. Cases are recorded where the alæ of the thyroid and cricoid cartilages have been injured or fractured. Keiller's experiments on cadavers led him to conclude, "(1) That ordinary falls on the larynx are not capable of causing fractures of the laryngeal cartilages, while even falls from a height with superadded force are unlikely to do so. (2) The severe pressure applied from before backward so as strongly to compress the larynx against the vertebral column, or violent blows inflicted over the larynx by means of a heavy body, may cause fractures of the larynx. Fractures so produced, however, will be most discernible on the internal surface, and generally in or near the mesial line. (3) Violent compression applied to the sides of the larynx (as in ordinary manual throttling or strangulation by grasping) is, of all applied forces, that most likely to produce fractures of the alæ of the thyroid cartilage, or even of the cricoid cartilage; and that fractures so produced are most perceptible, as well as most extensive, on the external (or anterior) surface of the larynx. By this lateral mode of applying force the hyoid bone is also the most readily broken. (4) The condition of the larynx in regard to the absence or presence of ossific deposit materially influences its liability to fracture from external violence."[2]

The right side of the heart, especially the auricle, and the venous system are engorged with blood; but this is not a constant post-mortem sign, as it is less frequently observed in this form of death than in other forms due to apnœa. The same holds true with regard to the congestion of the liver and kidneys. Occasionally the left side of the heart contains blood, and in some cases there is no blood at all in the entire organ. In those cases where the heart pulsates after the cessation of the respiratory function, the right ventricle is often found to be in a state of contraction similar to the cavities of the left side, and also nearly empty, the lungs being very much congested. Clots are occasionally found in the right ventricle.

[1] Virchow's Archiv, 1880, lxxix., etc.

[2] Tidy's Legal Medicine.

The lungs are occasionally in a state of congestion, as stated above, or they are normal. When congested they resemble red hepatization, with the exception that the blood is of a somewhat darker hue. Effusions of blood into the lung-substance are not uncommon. The patches of emphysema, as described by Tardieu, are occasioned by the rupture of the surface air-vesicles, either singly or in groups. They give to the lungs an appearance as if covered with a layer of white false membrane. Ogston states that these patches occur in pure strangulation, and in mixed cases to a less extent. Liman failed to note these appearances in the cases he observed.

Anæmia of the lungs sometimes exists. Bloody mucus mixed with froth shows in the bronchial tubes. There is usually much congestion of the mucous membrane, together with ecchymoses. The same conditions may prevail in the larynx and trachea. (*Vide* p. 361.) According to Tidy, the congestion of the air-passages in strangulation is always much greater than in asphyxia by hanging.

The brain may be in a normal state, or it may show evidences of congestion. Occasionally there are the signs of apoplexy. The rounded, minute ecchymoses of the inner surface of the scalp and pericranium are considered by Maschka as evidence of asphyxia.

There may be congestion of the abdominal organs, although, according to the last-named authority, this condition is not present in the liver and spleen.

Proof of Death by Strangulation.— *Was the strangulation the cause of death*, or *was the constricting force applied to the throat post mortem?* The reader is referred to the post-mortem signs (*ante*) for the external appearances of death by strangulation. "Nothing short of distinct external marks," says Tidy,[1] "would justify the medical jurist in pronouncing death to be the result of strangulation;" while Taylor[2] places the post-mortem condition of the lungs as characteristic. The following facts should be carefully considered in forming an opinion as to the value of testimony pro and con:

(1) Strangulation may be perpetrated without leaving any distinct marks. This is well illustrated in the case of the Thugs, who operated so skilfully by the use of a soft cloth. These cases are, however, exceedingly rare. (2) Persons bordering on epileptic or hysterical convulsions and intoxication often leave the marks of their thumbs and fingers on their necks, as a result of the frantic efforts made to breathe, in which they grasp their throats. (3) The swelling and lividity of the face, the ecchymosis at the bottom of the groove caused by the ligature, the protrusion of the eyes, etc., are not likely to be simulated post mortem. (4) Very similar marks on the neck may follow the employment of different encircling bands. Marks may be made on the neck after death, if the attempt is made within a limited time after dissolution and while the body is still warm. Casper states that this

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[1] Op. cit. [2] Op. cit.

not be accomplished after the lapse of six hours. Tidy fixed the limit ecchymoses at three hours, and for non-ecchymosed marks at six hours. nb[1] quotes Taylor as saying "that the period cannot be stated posi- ly, and probably varies according to the rapidity with which the body ls." It is scarcely probable that any swelling or lividity of the face l follow constriction of the neck produced even a few minutes after th. (5) Tardieu considers blood mixed with froth, in the air-passages, evidence of death by strangulation. The ecchymoses caused by stran- ation are more marked than in death by suspension. The last-named hority considers the minute ecchymoses of the face, conjunctivæ, and k more characteristic of strangulation than of hanging. (6) Strangu- on and suffocation are distinguished from each other by the absence of marks on the neck in the latter. (7) In strangulation, if a cord has been d, the mark will be horizontal; and if the hand has been the mode of plying force, the markings will be noticed upon the front of the neck; netimes it is possible to discern the marks of the thumb or of two or more gers on the throat, and in some instances the particular hand of the one aulting has been determined. As a rule, the marks of the ligature used strangulation are less deep than in death by hanging. Furthermore, it is t always possible to note the existence of any subcutaneous effusion of od. (8) Attempts at deception are often made by placing a ligature in se proximity to a corpse, or by even encircling the neck with it. In some these cases the neck may even show evidences of a mark. (9) Attempts avoid suspicion are frequently made, sometimes with success, by hanging destroying a body by fire after it has been first strangled. (10) Lamb tes that apoplectics (those with short and full necks) often show one or re depressions at the margins of the folds of skin in the neck, which are or livid, thus somewhat resembling ligature marks. The absence, on tion, of ecchymoses, however, serves to mark the differences. (11) The empt to simulate strangulation in a dead body could hardly be made for other purpose than to divert suspicion by inculpating an innocent person. ylor[2] says that "when an individual has been murdered, it is not likely t the murderer would attempt to produce the appearances of strangulation a body after death under the idea of concealing his crime; for strangu- on is in most cases a positive result of homicide, and is very rarely seen an act of suicide. In the absence of ecchymosis from the neck, it will be icult to form an opinion unless from circumstantial evidence. It must be nembered, however, that there may not always be an ecchymosed circle, an individual may be strangled by the application of pressure to the chea through the medium of the fingers or of any hard and resisting ma- ial. The ecchymoses in such a case will be in detached spots. In the sence of marks about the neck, we should be cautious in giving an opinion hich may affect the life of an accused party, for it is not probable that

[1] Op. cit. [2] Op. cit.

homicidal strangulation could be accomplished without the production of some appearances of violence about the larynx or trachea." (12) The external marks produced by strangulation may often be effaced by the process of putrefaction. (13) Murderers and suicides usually employ more force during the strangling than is actually necessary to destroy life. This is especially the case with murderers.

It is hardly necessary to impress upon the mind of the medical examiner the importance of taking particular notice of all marks of violence on the body of one supposed to have been killed by strangling. The three great cavities of the body should also be carefully examined, as it may be possible that the cause of death was other than strangulation, even when evidences of the latter exist. Another point of significance is the presence of blood, hair, etc., on the cord encircling the neck.

In estimating the value of testimony presented, no definite conclusion can be made from the presence or absence of any one sign.

Accidental, Suicidal, and Homicidal Strangulation.—*Accidental strangulation*, although of rare occurrence, occasionally happens. Taylor says, "When the body is not suspended, it is commonly more in the power of an individual to assist himself, and escape from the constriction." Lesser[1] mentions the case of an epileptic who, during a convulsion, was accidentally strangled from the pressure caused by a short collar. Reese[2] gives the following account of two cases of accidental strangulation recorded by Taylor. The first case was that "of a girl carrying fish in a basket, which was strapped around the upper part of her chest in front. She was found dead, sitting on a stone wall. The basket had probably slipped off while she was resting, and had thus raised the strap, which firmly and fatally compressed the trachea. The other case was that of a boy, whose silk necktie, knotted and twisted tightly around his neck, was caught in the band of an engine and his neck drawn down against one of the revolving shafts. He was rescued after his neck had been compressed at least one minute. He became black in the face, and blood escaped from the mouth and ears. For several minutes after the removal of the ligature he was insensible, but ultimately recovered." The difficulty of reaching a satisfactory conclusion in these cases is often increased where the body has been disturbed. Otherwise, there ought not to be any great difficulty in deciding whether the case be one of accidental strangulation or not.

Suicidal strangulation must be regarded as of exceptional occurrence. Among the insane, however, it is by no means uncommon. Fleischmann's experiments suggest the possibility of voluntarily compressing the fingers on the throat so as to produce strangulation and death. It is important in these cases to note the position of the knot. One knot tied either in front or behind the neck is consistent with self-destruction ; but more than one suggests

[1] Vierteljahrschrift für gesetzliche Medicin, Band xxxvi. p. 258.
[2] Op. cit.

homicide rather than suicide. Exceptions, of course, occur, and it is important for the medical jurist to keep this fact in mind. Beck[1] mentions the case of a female who took her own life by tying a handkerchief around her neck from behind forward, then made a knot and returned the free ends, and succeeded in making another knot at the back of the neck. Tardieu relates the case of a young girl who had the use of her right hand only, and who succeeded in strangling herself with a handkerchief or shawl rolled into a cord. She had passed it around the throat two and one-half times and secured it on the left side by two knots, the first knot being much tighter than the second one.

The methods of effecting strangulation with suicidal intent are various. Determined persons have committed suicide by the pressure on the neck of a cord secured at both ends a short distance from the ground. Others have succeeded in destroying themselves by winding a cord two or more times about the neck and securing it with a knot. In one case the ligature had been tightened by a sabre, and in another instance by a piece of wood. Lamb[2] refers to the possibility of strangling one's self "by means of the hands or feet or some portion of the lower limbs; by the use of a woollen garter passed twice around the neck and secured in front by two simple knots strongly tied one to another."

It is not easy to simulate suicide in a case of murder. "Thus," says Taylor,[3] "if the ligature should be found loose or detached; if the ecchymosis or depression should not accurately correspond to the points of greatest pressure; if, moreover, the means of compression were not very evident when the body was first discovered, and before it had been removed from its situation, there would be very fair grounds for presuming that the act was homicidal. In those cases in which the strangulation has resulted from compression of the windpipe by the fingers, and where there are fixed ecchymosed marks indicative of direct manual violence, we have the strongest presumptive evidence of murder, for neither accident nor suicide could be urged as affording a satisfactory explanation of their presence."

Homicidal strangulation is the most frequent variety of death by apnœa. It is readily recognized by the marks of the thumb, a single finger, or of two or more fingers. If there be marks of a ligature in addition, then the homicidal nature of the case is without doubt. It is worthy of mention that the pressure of the hands on the neck of an infant is sufficient to produce fatal results. (*Vide* Infanticide.) The marks just referred to may be supplemented by others on various parts of the body, indicating that an unnecessary amount of violence was employed, as is usual in homicidal cases. The impression made on the neck by the cord will be found to be deeper and more ecchymosed than is the case in suicidal strangulation; besides, the marks of the fingers on the neck, which are usually found, are never known to exist in suicidal or accidental strangulation. Furthermore, evidences of

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[1] Medical Jurisprudence, p. 579. [2] Op. cit. [3] Op. cit.

a struggle may be presented in the form of contusions or injuries on various parts of the subject. It should not be forgotten, however, that determined suicides often injure various parts of their bodies by successive attempts at self-destruction. This is especially the case with insane persons, who, failing to kill themselves by one method, finally succeed after trying another and another. Tidy[1] says, "The circumstance that the mark is not very distinct does not negative the idea of homicide, for strangulation may be employed to complete a murder, after the victim has in the first instance been rendered insensible by blows, drugs, etc. Hence in a case of strangulation it is most important to note (1) whether there is evidence of previous drugging; (2) the presence or absence of injuries to the head, etc.; and (3) the signs of struggling.

The marks produced by the ligature, etc., in homicidal strangulation may be discernible months and even years after interment. Schuppel, of Tübingen, mentions the case of a subject partially consumed by fire, in which the evidences of previous strangulation—the horizontal mark of the ligature and the protruded tongue—were found.

Homicidal strangulation may be effected without creating much noise, even when the victim and his murderer are in close proximity to other persons. It must be remembered that numerous cases of false accusations of homicidal strangulation are recorded.

Of recent cases of homicidal strangulation, that of Minnie Weldt is, perhaps, one of the most mysterious that New York City has known for a long time. The murderer was never apprehended. This woman's body was found lying upon the bed. Around her neck was a torn and dirty red bandanna handkerchief, drawn so tightly that it sank into the flesh. The ends of the handkerchief were tied in a knot under the chin, and the force employed to secure the knot had been so great that one of the ends of the handkerchief had been torn away. This piece was afterwards found lying on the floor by the side of the bed. The body generally had a composed appearance, showing conclusively that the woman had not anticipated her fate. On the left side of the face, about the eye, cheek-bone, and temple, was a large bruise, which was considerably swollen. But for this appearance it might have been surmised that the woman was asleep. She was lying upon her back, with one hand at her side and the other thrown back above her head. It is probable that she was rendered insensible by a blow on her head and then strangled, but she might have been drugged and made intoxicated before the murder. This would also account for the absence of the signs of a struggle.

Another recent case which elicited the interest of the entire nation was that of the student fiend who murdered two young girls, one of whom he strangled to death. The defendant was found guilty of murder in the first degree, in San Francisco, November, 1895. He murdered Blanche Lamont.

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[1] Op. cit., vol. iii. p. 269.

ad been strangled to death, and the marks of the murderer's fingers plainly to be seen on her neck.

ançois Case.—Louis François, a Frenchman, was arrested while on his the river carrying a sack containing the body of his wife. He said e had discovered her lying dead in the house, and, as he could not to bury her, had decided to throw the body into the river. The ns were removed to the station-house. External examination revealed scratches on the neck, about which a red silk handkerchief was loosely The face was considerably mottled, the spots being of a purplish hue, stive of death from strangulation. There was a flow of blood from the 1. The handkerchief, although found loosely about the neck, had stretched and the knots drawn tight. The only suspicious thing d about the rooms of François was a newspaper against the window bedroom. "The autopsy revealed four bruises of the scalp and er on the right side of the abdomen, causing extravasation of blood he tissue surrounding the liver and right kidney. There was a fracture e trachea (windpipe) from strangulation, finger-marks on the throat, lso those produced by the tightening of the handkerchief. The blood heart remained fluid, as it does in all cases of suffocation by inhaling inating gas, strangulation, etc. The lungs were congested and œde-us. They also showed conclusive evidence of strangulation." The usion reached was that the deceased could not have strangled herself.

HANGING.

of Death—Symptoms—Treatment—Post-Mortem Appearances—Internal Signs —Proof of Death—Accidental, Suicidal, and Homicidal Hanging.

anging signifies that mode of death by ligature in which the weight of ody acts as the constricting force. Hanging is said to be *incomplete* the body is partially supported, or in those cases which do not end in

he physiological effects of this mode of death are the same as strangula-the cause of dissolution being in part due to apnœa and to congestion brain, or to a combination of the two. Hanging is prescribed in some ries as a mode of capital punishment. It is also a frequent method of le, and instances of accidental hanging are not uncommon. Tidy[1] says t is occasionally done for erotic purposes, but this is hardly probable, as ensations are anything but agreeable. Murder is rarely committed by nding the body of the victim.

eath by suspension of the body does not always occur in the same ner, the final causes depending on (1) the rapidity with which the access mospheric air is arrested (asphyxia); (2) the force that the ligature ex-on the large veins of the neck (cerebral congestion and coma); the

[1] Op. cit., vol. iii. p. 237.

force applied to the great arteries of the neck (cerebral anæmia and s cope); and (3) the injury to the cord and pneumogastrics (neuro-paraly The subjoined table shows the relative proportion of each of these vari forms of death :

Forms of Death.	Remer.	Casper.
Apoplexy	9	9
Asphyxia (apnœa)	6	14
Mixed	68	62
Total	83	85

If the ligature is placed inferior to the thyroid cartilage, death is m speedy, and due to apnœa. If placed above, as in capital cases, it be retarded somewhat, on account of the change in position of the circling cord about the neck, which is apt to slip beneath the chin, t allowing a small quantity of atmospheric air to gain access to the lun Death in this instance is rather occasioned by congestion of the brain. the great majority of cases, however, a combination of causes is usually fou in hanging. Immediate death is caused in those cases where the *drop* is great as to fracture or dislocate the odontoid process of the axis, there causing pressure on the cord. This mode of death, however, is by no mea so common as is generally imagined. Orfila failed to discover a single fr ture or dislocation of the vertebræ in the bodies of fifty persons who suffer death by hanging. Taylor says that to cause death by fracture or luxati of the second vertebra, owing to pressure on the spinal cord, the drop mu be long and sudden and the subject heavy. Furthermore, the knot of t noose about the neck must be so placed as to be under the chin. T violent rotary swing that is sometimes given to suspended bodies by exec tioners adds considerably to the force that is applied in bringing about t displacement referred to.

According to Mackenzie, who examined one hundred and thirty cases death by suicidal hanging, the following table exhibits the proportion of t causes of each form of death :

Asphyxia	119
Asphyxia and apoplexy	8
Syncope	2
Apoplexy	1
Total	130

Asphyxia predominates if the ligature that encircles the neck be v tight, or loose and above the hyoid bone. A loose cord or ligature press against the hyoid bone or the larynx will occasion coma. A ligature pla beneath the lower jaw or the inferior part of the neck will tend to prod both asphyxia and cerebral hyperæmia. Respiration is completely arres

and asphyxia produced, according to Hofmann,[1] when the ligature crosses the neck between the larynx and hyoid bone. This result is occasioned by the pressure of the base of the tongue upward against the posterior wall of the pharynx. Immediate death follows when the cord presses below the larynx, as the supply of air to the air-passages is instantaneously arrested. If, on the other hand, the pressure be exerted against or above the larynx, death will be slower, as the air-passages are not completely occluded.

The immediate loss of consciousness is due to compression, especially of the carotid arteries, etc., against the transverse processes of the cervical vertebræ. This pressure produces rupture of the middle and internal coats of the artery, together with compression of the jugular veins and the pneumogastrics. The compression of the vagi causes an immediate loss of consciousness, which occurs simultaneously with the loss of the power of self-help. The causes of death by hanging may be threefold,—occlusion of the respiratory passages, interruption of the passage of blood to the brain, and compression of the pneumogastrics. (Hofmann.)

Among the *secondary causes* of death after apparent recovery from hanging are cerebral congestion and injuries affecting the nervous system. Death may take place at various periods as a result.

That death by hanging is painless, or nearly so, is unquestioned, as insensibility very rapidly supervenes. The convulsive movements of the extremities of the suspended body are no indication of pain. Resuscitation of persons after hanging is rarely accomplished, and even if partly so, the secondary effects—congestion of the brain especially—destroy life. The advent of insensibility is rather insidious. It serves to demonstrate the ease with which final dissolution occurs, even in those cases of partial hanging.

Symptoms.—In some instances the fatal termination is instantaneous and without symptoms. Where death occurs more slowly, as in suicidal hanging, there are certain signs. According to Tidy, hanging is divided into three stages,—viz., (1) a stage of partial stupor; (2) a stage of subjective death but of objective life; and (3) a stage of objective general death. The *first stage* is one of short duration, varying according to the length of the fall, the weight of the body, and the suddenness with which the ligature is constricted about the neck. As described by most authorities, the subject suffers an intense heat within the head, flashes of brilliant light in the eyes, sounds of a deafening character within the ears, and a heavy, numb-like feeling in the lungs. Consciousness lasts for but a very short period, being unaccompanied by acute pain. According to some writers, voluptuous feelings are experienced during this stage. This, however, is extremely doubtful. Spasmodic efforts at respiration are sometimes apparent, even after the occlusion of the air-passages.

During the *second stage* unconsciousness and convulsions occur, during which the face wears a painful expression, although not characteristic of

[1] Lehrbuch für gesetzliche Medicin, fifth edition.

suffering. Convulsions are not constant, but they usually occur. U
fæces, and semen are occasionally ejected externally; but semen is at t
found in the urethral canal, without any being expelled externally.
second stage varies in time from ten minutes onward. The *third* or *last s*
extends until the period of rigor mortis supervenes. Here, with the ex
tion of the heart-beat, no phenomena are presented. Note of the beats of
heart may, as a rule, be taken for a period of ten minutes. Pulsations of
right auricle have been observed when the body has been cut down after
usual period of hanging. These beats continued, at intervals, for a pe
of three and one-half hours, and were readily excited by the point of an
strument.[1] In one case (according to Tardieu) note of the pulsation of
subject was taken from the termination of the usual period of suspen
until the lapse of one and one-half hours after supposed death. The b
recorded were at the rate of eighty to the minute. This phenomenon
probably due to incomplete occlusion of the respiratory passages and to in
ficient pressure against the great vessels. In such instances as the one
cited, and where no evidence of injury to the tissue exists, life may oc
sionally be restored within a period up to half an hour. The usual pe
at which dissolution occurs is five to nine minutes.

Of *incomplete* hangings, out of 261 cases referred to by Tardieu, the
of the subject came in contact with the floor in 168 cases; while 42 c
were discovered to be on their knees, 29 lying down, 3 squatting, and
in a sitting posture. Hackal reported 67 cases of suspension of the bo
of which thirty-four per cent. were "incomplete." As a rule, the limbs of
upper part of the subject may assume any position, while those of the lo
part arrange themselves according to the position assumed by the body
the dead person.

The following is quoted from Lamb.[2] "In some countries, as the Uni
States, England, Germany, and Austria, hanging is the mode of capital p
ishment. It is desirable that for judicial purposes it should be divested
far as possible, of unnecessarily cruel features; the victim should quickly
made insensible, and death be speedy. Many suggestions to this end h
been made, among which is that of Haughton. He recommended that
drop be long, say ten feet, so that the cervical vertebræ may be disloca
He also advised that the knot be placed under the chin. Others advise
it be placed under the left ear; and others yet, as Barker, of Melbourne,
the spine. In any event the rope should be freely elastic. Dr. G. M. H
mond thinks that the object in judicial hanging should be strangulation,
that the criminal should be pulled up and left to hang thirty minutes;
rope should be soft and flexible so as to closely fit the neck; a weight sh
be attached to the feet of persons under one hundred and fifty pou
Larimore also advocates strangulation instead of attempting dislocation

[1] Clark, Boston Medical and Surgical Journal, 1858, lviii.

[2] Op. cit.

the vertebræ. Porter suggests that for dislocation the noose be drawn tightly around the neck at the last moment, the knot being either at one side or, still better, in front. Dislocation may be still further assured if a hollow wooden or leaden ball be placed over the knot close to the neck, thus forming a fulcrum to throw the spinal column out of the perpendicular line at the point of pressure."

Treatment.—As stated before, very few persons have been brought back to life after hanging. The first thing to be done is to cut the body down, and then remove any clothing that might interfere with the movements of the chest or in any manner constrict the neck. This done, the medical man must immediately attempt to re-establish the action of the respiratory apparatus,—in other words, induce the natural process of breathing. It must be remembered, however, as a point of the greatest importance, that nothing in the way of bringing about the respiratory action can be accomplished unless all constrictions of the neck and chest are removed. The tongue of the subject must be prevented from blocking up the air-passages; for, as is well known, it has a tendency to fall backward in the throat and occlude the upper end of the larynx. It should be drawn forward and secured in that position by an india-rubber band, string, or tape passed around its base and under the chin. The alternate expanding and compressing the lungs to imitate the natural process of respiration should be thoroughly practised by any of the methods so commonly employed in these and similar instances. The action of the heart should be promoted, and the overloaded vessels relieved by the application of heat to the præcordial region and to the abdomen. Friction of the limbs aids in restoring warmth and the circulation; so, likewise, the use of warm clothing, hot flannels, blankets, hot bottles, etc. If the patient can swallow, accelerate the vital actions by giving small doses of stimulants. Attempts should also be made to stimulate the natural breathing powers by the application of ammonia, etc., to the nostrils, and by slapping the chest alternately with cloths wrung out of hot and cold water. The animal heat must be maintained at all hazards. Congestion of the brain or distention of the right heart and pulmonary circulation often call for venesection. Galvanism may be tried. A man, aged sixty-two years, made the attempt to commit suicide by hanging, and when found presented no symptoms of life. Venesection, electricity, etc., were employed, with the result that he recovered. During his convalescence, congestion of the right lung, accompanied by a limited pleuritic effusion, occurred. The temperature dropped three degrees subnormal, but with the return of consciousness it rose three degrees above the normal.[1]

Post-Mortem Appearances.—These greatly resemble those following dissolution from strangulation. They show both externally and internally. The *external signs* are turgescence and lividity of the face. Out of forty-nine cases of death from suspension, Roth found that in forty-three the

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[1] Lancet, 1870, i. p. 446.

face was pale. In some the features are calm and placid. The lips ma tinted blue. The eyelids are congested; the eyes red, protruding, prominent, while the pupils are usually dilated. The ecchymoses of eyelids and conjunctivæ are often looked upon as suggestive of hangin strangulation. (Lacassagne and Maschka.) The tongue is generally swol livid, frequently protruded or compressed between the jaws. Guy consi the turgescent state of the base of the tongue as favoring the idea of hang during life. The position of the ligature has nothing whatever to do w the protrusion of the tongue. The lower jaw is usually retracted. In dition to these signs there are frequently bloody froth escaping from nostrils and mouth, and petechial effusions on the neck, shoulders, arms, hands. The position of the head is subject to variation, according to situation of the knot. In suicidal suspension the head is commonly thro forward, as the knot is usually at the back of the neck; but if the knot in front, the head will be extended backward, as in cerebro-spinal meningi Tidy says that "the head will always be found inclined to the opposite side that of the knot, which answers to its fixed attachment."

The position of the hands is also subject to variation. They are, h ever, usually closed tightly. When the suspension has been violen effected, the finger-nails are often found sunk into the flesh. In cases of complete hanging the hands or fingers may be extended, or even resti open on the floor or ground. The legs also vary in their position. Th are generally extended, and often livid. The neck is almost always *on stretch*, on account of the weight it carries. It presents the marks of t cord employed in its constriction. These marks are subject to variati according to the nature of the ligature and its mode of application. Un the mark may be observed the parchment-like skin, which assumes a v decided appearance if the suspended body is not interfered with for so hours or days. The cellular tissue underneath is also very dense tough, assuming a silvery appearance. (Reese.) Where the hanging been violently effected, as in capital cases, there is still another ma livid in color (ecchymosis), which is entirely independent of the t mark of the ligature. It is not constant. The furrow in the neck found in four-fifths of the cases above the larynx, between the latter the chin, while in the remaining fifth it is over the larynx, although it been discovered below the latter. The direction of the furrow or mark usually oblique (*vide* Strangulation), but it may be double, irregular, or terrupted. Thus, one mark may be circular and the other oblique in di tion, etc. The depth of the furrow varies with the width of the encircl cord and the time of the suspension. If the former be very narrow and latter extended for some hours, the depth of the furrow will be increas Tidy[1] says, "If the hanging be very rapid, the ligature soft, and the b cut down instantly after death, there may be little or no mark at all. If

[1] Op. cit., vol. iii. p. 245.

suspension be comparatively brief, the person young, and the skin and blood-vessels healthy, the mark may be merely a slight depression, without change of color, or with at most a red blush. More frequently the bottom of the furrow (that is, the point of greatest pressure) appears white (a condition recorded in 67.5 per cent. of Ogston's cases), the spot indicating the knot exhibiting a more intense whiteness. The edges of the furrow are usually slightly raised and red, the skin beyond the edges of the furrow being of a violet color, depending, according to Ollivier (d'Angers) and Causse (d'Albi), on congestion, but according to Remer, on extravasation. Further, the mark of a single cord may exhibit more than one of these various appearances. In very fat subjects a mere white depression is often all that marks the course of the cord. . . . It must be noted that the mark of the rope may not be apparent along its entire course, and, further, that when once distinct it remains constant and apparent for a long period after death."

Sometimes there is swelling and congestion of the genital organs. Erection of the penis may be evident, and its size may be greatly increased. There may be an involuntary discharge of seminal fluid, but generally prostatic. This is often tinged with blood. Erection of the clitoris may exist, and evidence of menstrual blood may be present. According to Orfila, turgescence of these organs, together with the expulsion of semen, may be effected, as is demonstrated experimentally *post mortem* in those who have been hanged *ante mortem.* The erection of the male organ may occur some time after dissolution. Involuntary evacuations of urine and fæces also take place, but, as these signs are not pathognomonic of death by suspension, occurring as they do in other forms of death by violence, they are not of any considerable medico-legal importance. In addition, there is invariably in hanging a flow of saliva.

Internally, among the occasional lesions met with, especially where the suspension has been violently done, as in executions, are ruptures of the muscles, particularly the sterno-cleido-mastoid. The rupture of the latter, according to Hofmann, is occasionally post mortem. The cartilages of the larynx may be fractured or luxated. These lesions are more frequently seen in cases of homicidal hanging and in suspension violently effected than in suicide, where they are of comparatively rare occurrence. Fracture of the hyoid bone is scarcely ever met with. Harvey reports laceration of the trachea in several cases. Luxation of the vertebræ of the cervical region may occur in judicial suspension; and fracture of the odontoid process of the axis with rupture of its ligaments, luxation of the atlas and axis, and lesions to the spinal column likewise. Other occasional lesions are ruptures of the internal and middle coats of the common carotid arteries, and consequent hemorrhage into the wall of the vessel. The external carotid artery is rarely involved. This injury is probably due to the stretching and squeezing of the vessel. These lesions in no way prove that the hanging took place during life. The membranes of the larynx and trachea

usually congested a deep red. If the process of putrefaction has begun, the color will be violet. Froth is usually seen in the bronchi and trachea, and in one instance at least the larynx and pharynx contained blood. Mucus in the upper part of the trachea and in the larynx sometimes exists. This, according to Chevers, is an invariable post-mortem sign.

The conditions of the heart and lungs vary according to the mode of death,—viz., from asphyxia, syncope, etc. Serum in the pericardium is occasionally found, but more often in strangulation, owing to the death being slower. The right side of the heart and the venous system are engorged with dark fluid blood. When the death has been caused by apoplexy, both ventricles of the organ contain blood ; but if dissolution be due to asphyxia, the cavities of the left side will be found empty, while the right side of the heart, the pulmonary artery, and other great blood-vessels will be full of blood. The lungs are congested with blood, although Wilson, of Alabama, refers to a very rare exception to the congestion of the lungs in suspension in the case of a man (colored) of twenty-two years. Cessation of the heart-beats occurred twelve minutes after the fatal drop. On post-mortem examination, performed an hour afterwards, *collapse of the lungs* was discovered. They appeared in all other respects perfectly normal. The fluid was noticed in the pleural cavities. The right side of the heart was full of dark blood. The stomach contained a small quantity of blood, and was deeply congested.[1] Subpleural ecchymoses are observed in a few cases. Congestion of the cerebral vessels is usually present, but effusion of blood within the brain or upon its surface is rarely observed. Section of the brain often reveals the presence of bloody points. The kidneys are usually in a state of congestion ; and so deeply hyperæmic is the stomach that the medical examiner is often unable to determine whether the congestion be due to the effects of poisoning or to hanging. The intestine often presents similar conditions. Coagulated blood may exist upon the walls (mucous membrane) of the stomach.

Fracture of the crystalline lens transversely is frequently produced by suspension of the body. (Dyer.)

Proof of Death.—*Was the hanging the cause of death?* Tidy says: "Neither the finding of a cord around the neck of a dead body nor the marks of a cord around the neck prove death to have taken place by hanging." The examination of a case of this kind requires careful consideration of the signs presented, both externally and internally, with a view of forming a distinction between them. No one sign in such an instance will suffice to prove that the death was caused by hanging. Therefore this is a question not always satisfactorily answered, since the evidence usually presented for consideration is neither positive nor characteristic of this form of dissolution. It is by a careful examination of the external and internal appearances of the body only that a definite conclusion can be arrived at.

The mere discovery of a suspended body does not signify that the cause

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[1] Medical News, July 5, 1890.

of death was the hanging. Murderers, for purposes of deception, commit their crimes and then suspend the bodies of their victims. Chevers refers to many such cases where the victims were first strangled and then hanged after life was extinct. Important evidence may be gleaned from the character of the ligature-mark on the neck, although this cannot always be satisfactorily determined, since the mark can be simulated by hanging a dead body, even, according to Casper, seventy-two hours after dissolution. This is especially true if a weight be attached to the body, or it be forcibly jerked downward. Tidy says,[1] "that, provided the tissues preserve a certain amount of vitality, a cord will produce marks after death very similar in appearance to those resulting from its application during life, except in the presence of effused coagula about the cord, a condition at all times strongly suggestive of suspension during life. And, secondly, that if the cord were applied during life, but removed immediately after death, scarcely any marks at all might be apparent." Several observers, Orfila among them, state that the dense and tough connective tissue, the lividity, and the parchment-like skin under the ligature-mark will be apparent in a body suspended within an hour or two after death just the same as during hanging in life. The ecchymoses, infiltration, and clotted blood in the skin, muscles, etc., of the neck suggest suspension while the subject was alive.

An invariable sign of death by suspension, according to Hutchinson, is the flow of saliva out of the mouth, down on the chin, and straight down the chest. The possibility of the occurrence of this after death is out of the question, as the flow of saliva is a living act. Another important point to be taken into consideration when deciding this question is the careful observation of the surroundings of the subject.

Accidental, Suicidal, and Homicidal Hanging.—Suspension of the body is usually suicidal, although it not infrequently occurs among children and even older persons as a result of *accident.* Thus, children while at play, as swinging, often become entangled in a loop of rope, etc., which, becoming caught underneath the chin, strangles them to death. Taylor mentions the case of a man who was undoubtedly hanged by accident. The subject was in the habit of exercising on a rope, and when discovered was suspended in his room. The rope had passed twice around the body and once around the throat, thus causing strangulation. These cases are, however, rarely seen, and it is only by circumstantial evidence that they can be discriminated. Cases are on record where suspension was caused by persons being caught by the neck by the fall of a window while looking out into the street.

Suicidal suspension is, as previously stated, the most frequent method. Of three hundred and sixty-eight deaths by suicide, Lesses states that one hundred and eighty-nine were the result of suspension. According to Pellier, there were thirteen thousand four hundred and forty-five cases of

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[1] Op. cit.

suicide in France between the years 1876 and 1880, nearly all of which we the result of hanging; and within a period of five years in England tw thousand five hundred and seventy persons killed themselves by suspensio Most all of the cases reported by Harvey as occurring in India—some four teen hundred and twelve—were suicidal hanging. The position assumed by the subject does not afford positive evidence, since it has been frequently demonstrated that the perfect suspension of the body is not requisite to cause fatal results. Of the cases collected by Tardieu,—a total of two hundred and sixty-one,—the body was found after death resting upon the feet in one hundred and sixty-eight cases; upon the knees in forty-two cases; upon the buttocks (sitting posture) in nineteen cases; extended and lying down in twenty-nine cases; and in three cases huddled up or squatting. In a case referred to by Reese,[1] the body was supported by a bed, the neck resting in a leather ligature. It frequently happens that those bent on self destruction actually bind their hands and feet previous to hanging them selves. Hence the discovery of a hanged person with hands and feet bound would not of itself justify the presumption of murder. If, however, such a person was found suspended in such a way that the position could not possibly have been taken by himself, the presumption of homicide could readily be entertained. Suicide being common at all periods of life, even in childhood, the age of the subject cannot be taken as evidence in solving the question. A young boy or girl being discovered dead from suspension would naturally lead the discoverer to attribute the death to either accident or homicide. But, as is well known, children frequently commit suicide by suspension. The writer has already called attention to this fact.[2]

The following circumstances must be carefully considered ere framing any reply to the question whether the death from hanging be suicidal o not. The surroundings, the absence of bruises or other injuries on th body, or of signs of struggling, the history of the victim, etc., all are ev dences of suicidal hanging. Nevertheless, as Lamb states,[3] suicides "som times also wound or poison themselves first and hang themselves afterward. Further, the same writer says, "The possibility of a suicide breaking a rop being injured by the fall, and rehanging himself successfully must be a mitted. The possibility of blood flowing after death must not be forgotte It is worthy of note that after beating or other violence, children and wom may commit suicide from shame. Again, as Tardieu says, many have hu themselves while partially intoxicated, and it is likely that some such hav just previous to the suicide, met with falls or other accidents which have l marks like those of violence."

The occurrence of *homicidal hanging* is rare. Taylor[4] says, "It h been very truly observed, that of all the forms of committing murder hangi

[1] Op. cit.

[2] Causes of Suicide, June 10, 1894, by Justin Herold, A.M., M.D.

[3] Op. cit. [4] Op. cit.

is one of the most difficult, and it is, therefore, but seldom resorted to." The presumption of homicide would be justified where the injuries caused by the ligature are severe, where there are contusions and ecchymoses, and where fractures or luxations of the cartilages of the larynx, the hyoid bone, or the vertebræ of the cervical region exist. Further, murder may be suspected in those cases where wounds of the throat, carotids, heart, etc., are apparent, where marks of violence exist, or where indications of a struggle are shown. If a person be discovered with hands and feet bound, and hanging, the homicidal character of this condition would appear to be clear; but, as previously stated, determined suicides sometimes tie their hands and feet before hanging.

It is possible that wounds found on a dead body from hanging might have been inflicted by the deceased himself; hence it is very important for the medical examiner to make note of the situation, number, extent, and direction of such injuries. Murder by hanging may be committed on those who are debilitated or feeble, on children, women, and old persons, by a strong, healthy person. Or, again, homicidal hanging may embrace those who are narcotized or intoxicated or who are the victims of more than one assailant, and thus unable to defend themselves. Frequently, for the express purpose of diverting suspicion, a murderer will administer poison or inflict injuries previous to the hanging.

When a person is found dead from suspension in a room the windows and doors of which are securely locked or fastened on the inside, the presumption of suicide would be justified.

The following outline for the inspection and examination of a subject in a case of *hanging* or *strangulation* is quoted in its entirety from Dr. Tidy's "Legal Medicine," vol. iii. p. 251. "It is advisable to have a photograph taken of the body, as well as of the furniture and of other articles in the room, before anything is touched."

General Inquiries.

Was the room locked on the inside, without other possible means of escape?

Were any fire-arms or other weapons, or marks of blood, or signs of struggling noticed about the room?

Is the dress of the deceased torn or the hair disarranged?

Does the dress, etc., indicate any interference with the body after death?

Note the position of the body and the character of the dress worn (a tight cravat?).

What is the weight of the deceased? (This is important if a question should arise as to the power of the cord to sustain the ascertained weight.)

Notes respecting the Ligatures used.

If the ligature is still around the neck, carefully note (or, better still, sketch) its exact position, the number, the character, and the method of tying the knot or knots (that is, whether the tying was the work of a right- or left-handed

person), and the exact position of the knots. Remove the cord by cutting so as to leave the knots intact.

If the ligature has been removed, ask for it.

Preserve and retain the ligature for evidence. It may be needful to compare it with some material either in the possession of an accused person or belonging to the deceased, or its possession may be traced to some one else.

Note the material of which the ligature is composed.

Do the ends of the ligature appear (if a rope) to have been freshly cut?

Compare the ligature with the impression on the neck. Note whether there is any brown line on the ligature, such as might result from perspiration.

What is the length (or weight-bearing power) of the ligature by which the body was suspended?

Are there any marks of blood or of hair or other matters adherent to the ligature?

External Appearances.

Are there any marks of violence on the deceased, or other than directly caused by the hanging or strangulation?

By what instrument were these marks (if present) likely to have been inflicted?

Are they sufficient in themselves to account for death? or, if not sufficient, are they of such a character that they would induce great weakness from loss of blood?

Were they probably accidental, suicidal, or homicidal (*i.e.*, likely to be caused in a struggle)?

Note:

Face.—Pale? Swollen? Placid?

Mouth and Nostrils.—Foam?

Tongue.—Position? Color? Whether injured or not?

Eyes.—Prominent? Color? Whether injured or not?

Pupils.—Dilated?

Neck.—Note:

Character of Marks.—Presence of a groove? Whether it be complete or not? Color of the borders of the groove and of the parts beyond? Marks of fingers, etc.?

Direction of the Marks.—Whether oblique or not? Note the apparent position of the knots.

Statement of the integument in the furrow.

Any excoriations or ecchymoses?

Hands.—Bloody? Clinched? Anything in the hands? (Carefully preserve any hair, etc., that may be found grasped or attached.)

Sexual Organs.—(In the male, note if there be spermatic fluid in the urethra.)

Internal Appearances.

Neck.—Dissect out the mark around the neck, cutting for this purpose through the skin an inch above and an inch below the mark. Note the state of the underlying tissues, the presence of coagula, etc.

The entirety or otherwise of the muscles of the neck?

Effusion of blood among the muscles and ligaments?

Injury to the larynx and trachea?

Injury to ligaments of neck?

Injury to the bones (especially the hyoid bone, atlas, and axis)?

Injury to the intervertebral substance?
Injury to the spinal cord (effusion of blood, etc.)?
Carotid Arteries.—Condition of inner and middle coats? Whether or not there are extravasations of blood on the walls or within the vessels?
Brain and Membranes.—Congested? Vascularity?
Larynx and Trachea.—Congested? Mucous froth?
Heart.—Right side full?
Stomach.—Congested? Presence of food? Presence of poisons (such as of opium, etc., given to drug the deceased, or for other purposes)?
Lungs.—Congested? Emphysematous patches on the surface? Apoplectic extravasations in the substance?
Are there any morbid appearances that would account for death otherwise than by hanging or strangulation?
Has there been any disposition on the part of the deceased to commit suicide, or is insanity hereditary in the family?

DROWNING.

de of Death—Symptoms of Death by Drowning—Treatment of the apparently Drowned—External and Internal Signs of Drowning—Time of Submersion—Accidental, Homicidal, and Suicidal Drowning.

Drowning signifies death from the arrest of the supply of atmospheric to the lungs by water or any liquid medium. It is not necessary that erson asphyxiated by submersion be immersed completely to cause th; for, as is frequently witnessed, drunkards, very young children, se subject to epileptic convulsions, etc., perish in shallow pools, or in es where the depth of water is scarcely sufficient to occlude the nose mouth. New-born children may even be suffocated by the fluids of mother.

The specific gravity of the human body is a trifle greater than that of er, notwithstanding the fact that the bones and muscles have a greater sity; for the air within the lungs and the fat, which is specifically lighter, d to restore the equilibrium. From this fact it becomes apparent that ery slight exertion on the part of the person in the water is all that is uisite to enable him to remain at the surface. This tendency, however, inishes when any part of the subject remains out of the fluid, because additional weight is added to the portion beneath the surface, and the ly sinks. Thus it is that inexperienced persons are lost by their own rtions. Fat persons float more readily than lean persons; women better than men; and infants better than either, owing to their fatness, small portionate extent of bony surface, and imperfect development. Those sons whose chests are large and well developed remain at the surface of a id more easily than those whose chest development is small. This is due the immense quantity of atmospheric air within the chest, which buoys m up. The tendency to sink during the process of expiration is owing to supply of air becoming exhausted; hence the tendency to rise is manifest ing inspiration and to sink during expiration. Taylor states that in many

cases there is a proneness for the dead body to float very soon after the drowning.

Death from drowning, under ordinary circumstances, is due to asphyxia or the presence of an excess of carbonic acid in the blood.

The following description of drowning is from Reese's "Medical Jurisprudence and Toxicology." "When a person falls into the water and retains his consciousness, violent attempts are made to breathe; at each time that he rises to the surface a portion of air is received into the lungs, but, owing to the mouth being on a level with the liquid, water also enters and passes into the throat. A quantity of water thus usually enters the mouth, which the drowning person is irresistibly compelled to swallow. In his efforts to breathe while his head is below the water, a portion of this liquid is drawn into the air-tubes and cells of the lungs. The struggle for life may continue for a longer or shorter period, according to the age, sex, and strength of the person, but the result is that the blood in the lungs is imperfectly aërated, the person becomes exhausted, and insensibility follows. The mouth then sinks altogether below the level of the water; air can no longer enter into the lungs; a portion of that which they contained is expelled, and rises in bubbles to the surface; an indescribable feeling of delirium, with a ringing sensation in the ears, supervenes; the person loses all consciousness, and sinks asphyxiated. In the state of asphyxia, while the dark-colored blood is circulating, convulsive movements of the body take place, and the contents of the stomach are sometimes ejected by vomiting. There does not appear to be any sensation of pain; and, as in other cases of asphyxia, if the patient recovers, there is a total unconsciousness of any suffering."

Asphyxia supervenes in about two minutes after submersion, and death occurs, ordinarily, about five minutes later. Besides death beginning at the lungs (asphyxia or apnœa), there are many other causes which either modify the circumstances of the death or directly cause it. Among these are the following: concussion, exhaustion, cerebral congestion, syncope; or the cause may be a mixed one. Furthermore, the death may be owing to secondary causes; as, for example, where pneumonia supervenes as the result of physical injury to the lungs from water penetration. Rosse[1] refers to the case of a drowning boy who, after resuscitation, perished from cholera owing to the contaminated water in which he was submerged.

Concussion as a cause of death in drowning may follow the violent contact of the chest, head, etc., with the surface of the water, with the banks of the stream, with the river-bed, rocks, etc. *Exhaustion* usually follows the violent and unsuccessful efforts of the drowning person to keep afloat. Again, it may be occasioned by the waves, the strong currents, the high winds, etc., with which the person has to contend in his efforts to save himself. *Cerebral congestion* has been ascribed by some authorities as a cause

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, p. 796.

ath in drowning. It results from effusions of serum or blood during preliminary struggles for atmospheric air, or "possibly," as Tidy s, "in the case of suicides, immediately before the person jumps into vater." Apoplectic conditions, says Taylor, are also referable to other es unconnected with cerebral disturbance, for the same degree of con- ion is perceived not only in other cases of asphyxia but also in deaths to violence. Hence death by drowning cannot always be attributed to poplectic attack. The effusion of blood spoken of is not characteris- as a post-mortem sign of death from submersion in liquids; while, on other hand, it is the principal sign of apoplexy after death. *Syncope* ıro-paralysis) may follow shock superinduced by fright, intoxication, hys- a, etc., at the time of the drowning. Here it is possible for the person lrown without making any efforts or struggles for life, on account of the ervention of insensibility at the moment of immersion. But, according Tidy, "nothing short of complete syncope, which would be fatal either in out of the water, could entirely prevent some of the results of death by hyxia." In *cramp*, tetanization of the muscles of the extremities is ceeded by spasm of the respiratory muscles and possibly of the heart. *ck* is likely to occur in those cases where the action of the heart is feeble l the circulation of the blood retarded. In epileptics the sudden spas- dic seizure may induce this condition. Regarding *mixed cases*, Taylor s, "It is obvious that they who die from apoplexy, concussion, or cope, at or about the time they fall into water, cannot be said to die m drowning. An individual so situated makes no effort to respire, and s only by interfering with respiration that the water operates. Admitting, n, that in strictness asphyxia is the sole cause of death in drowning, these xed cases are of interest in medical jurisprudence only because the ap- rent may be mistaken for the real cause."

Symptoms of Death by Drowning.—Three stages are passed through a person asphyxiated by drowning. First, shock is experienced, followed what has been termed a "surprise inspiration," which fills a great portion the respiratory passage with liquid. Occasionally a second inspiration ll take place. Then the second stage, sometimes called the "period of istance," or the "dyspnœic stage," supervenes. Here the drowning rson has stopped inspiring, and the face and brain become congested, ile general movements ensue. Forcible involuntary expirations are an ac- mpaniment to the above, until the person finally becomes insensible, and sses into the third stage, or that of asphyxia. In this stage deep gasps are ıde, dilatation of the pupil is observed, the extremities are violently agitated clonic spasms, and death, preceded by complete unconsciousness, speedily lows.

Dr. Rosse[1] gives the following excellent and interesting description of rtain phenomena frequently present in drowning persons, and related by

[1] Op. cit., p. 799.

them upon resuscitation. "Among the symptoms often present in drowning persons, many relate to nervous phenomena and the mental state, which may vary with individual presence of mind and moral force. Persons who have escaped this kind of death have observed auditory and visual hallucinations, as flashes of light, the ringing of distant bells, and the like. Just before the outset of the asphyxiation a rather curious functioning of the brain, known as hypermnesia, takes place, in which the reviviscence of ideas, of objects, or of facts relates to anterior impressions long past that seem to have been forgotten. According to the narratives of many drowning persons who have escaped the last consequences of asphyxia, this condition was attended by general exaltation of the memory of such a nature that their whole previous conscious existence seemed, in an incredibly short period and with great clearness and precision, to pass before them in panoramic review. In Admiral Beaufort's letter to Dr. Wollaston the memory impressions are said to have occurred in retrograde succession. A medical man resuscitated from drowning reports that just before losing consciousness this particular cerebral activity in his case took on a most realizing sense of the situation and of the consequences to his family. This cerebral superexcitement is not, however, a constant thing, nor do all subjects experience the ineffable agony of drowning. Persons have been taken from the water apparently dead, who, on regaining consciousness, declared that they experienced neither oppression nor suffering, and had no recollection of what had passed. A very intelligent woman of my acquaintance, having such an experience a few years since at Newport, quotes herself as, and really believes that she is, an instance of a person once dead and afterwards restored to life. This peculiar vividness of mind has been observed in other kinds of death than drowning, notably in chronic insanity. A priest with extended experience at the Government Hospital for the Insane tells me that he has often noticed the *vaticinatin morientium* in the form of so-called lucid interval of the insane when called on to administer the last rites of the church. The condition is explainable from the stoppage of the pulmonary artery and the stimulus caused by circulation of non-oxygenated blood in the brain.

"The condition known as asynesia, or amnesia, sometimes follows the return to consciousness in persons asphyxiated and apparently dead from drowning. Dr. F. A. Burrell reports the case of a boy of eighteen, submerged for six minutes, and resuscitated after four and three-quarters hours, in whom the memory of everything that had occurred from half an hour previous to the accident up to the return of consciousness had been entirely obliterated. When last heard from the lapse of memory still remained." (*Vide* External Signs of Death from Drowning.)

Treatment of the apparently Drowned.—In connection with the treatment of the drowned, it is of importance that the physician bear in mind the physiological effects of drowning, and remember especially that the cessation of breathing is not a positive sign of death, but that the actual stoppage of the action of the heart is. A question of paramount importance

in connection with the treatment of these cases is, *How long a period of entire submersion is necessary for dissolution to occur?* or, in other words, *When is there no further hope of resuscitating a drowned person?* Taylor says that the unconsciousness which follows submersion will cause a body which has been in the water for a short period only, even seconds, to assume the characters of apparent dissolution, a result which by no means implies that the victim is beyond reach of recovery, or that the means which are at hand to restore consciousness are to be neglected in their application. A person would be almost criminally negligent were he not to apply the means of resuscitation without hesitation or delay, notwithstanding the fact that, physiologically speaking, ultimate recovery would be questionable. The application of this principle might be the unexpected means of restoring to life one who would otherwise be consigned to certain death. Hence the shortness of the time of dissolution in cases of submersion must not be a barrier to the speedy treatment of the drowned. It often happens that two or more persons are drowned under like circumstances, and, on being removed from the water, are subjected to the same treatment. In one case the effect of treatment will be satisfactory, while in the other cases its successful operation is *nil*. Hence the importance of keeping fresh in mind the fact that the time of dissolution and the susceptibility to the restoration of consciousness may be entirely dissimilar in the different persons. Some individuals have been restored to life who there was every reason to believe were completely under water for a period of five minutes, while, on the other hand, it has been found utterly impossible to resuscitate some who had fallen into water and were submerged but for a minute, and who, besides, still possessed all the heat and pliancy of life. Of course such cases are of very rare occurrence, and, were it not for the authenticity of the reported cases, we would be led to surmise the unreliableness of such statements. (Taylor.)

Voisin[1] holds the almost positive certainty of resuscitating a person apparently drowned within five minutes, while he successfully restored to life one person who had been submerged for a period of twenty minutes.

When a subject is recovered from immersion in the water, means for aiding the respiratory powers should be had recourse to, and these should be continuously applied until consciousness returns or until the case is abandoned as without hope. The treatment of a subject in bringing it back to life must be conducted similarly to that pursued when restoring living persons to health; or, in other words, we should be very careful not to abandon a person whom we think dead, even though there be every reason to fear this may be the case. In a case reported by Douglass,[2] success was not attained until a period of eight and one-half hours after submersion; and in another, mentioned by Bloomfield, one and one-half hours elapsed before there was any sign of returning animation.

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[1] Gazette des Hôpitaux, 1882. [2] Medical Gazette, vol. xxxi. p. 449.

Treatment should be commenced at once and on the spot. The body clothing should be removed, and the person placed face downward, as the air-tubes are often filled with water. The operator should then take hold of him underneath the abdomen, in order to force out the intruded water. The mouth and nostrils are then inspected and cleansed, and artificial respiration begun. During this process attention should be directed by an assistant to the removal of the lower garments, and the protection of the surface of the body by means of blankets or other available articles. For the restoration of animal heat recourse must be had to friction, hot bottles or water-bags, flannels, etc. Stimulants are indicated for the heart. The other indications for treatment are to rouse the nervous centres and to repel the tendency to death from inflammatory or other secondary causes.

The following account of the resuscitation of the apparently drowned by making traction on the tongue (Laborde's method) will be of interest, since it affords opportunity of introducing Laborde himself as a life-saver:

"During the summer months M. Laborde resides at a small sea-side resort in Normandy, and he explained before the Académie de Médecine, in Paris, how, when the tide is rising, persons out fishing are exposed to be taken by surprise among some very dangerous rocks. A young man of thirty years and a boy of fourteen were surprised and apparently drowned. The boy's father, who had not left the top of this ridge of rocks, saw the danger, rushed into the water, and succeeded in finding his son. He then went after the young man, and was fortunately able to drag him on to the beach as well, whereupon the two victims were carried home. The boy was not long in regaining consciousness, but the young man, in spite of all the efforts of two physicians, summoned in haste, gave no sign of life and was considered dead.

"At that time M. Laborde was some distance inland fishing along a stream, and although he had been sent for when the accident happened, it was a full hour before he could reach the spot, and to all appearances the man on the bed was quite dead. The pulse was imperceptible, the beating of the heart could not be detected, and the breathing sounds were absent. However, on raising the eyelid, M. Laborde thought that the smallness of the pupil did not harmonize very well with a confirmed state of asphyxia and final death. He immediately had recourse to a process with which he had succeeded once before in a similar case. Pushing a spoon into the pharynx, with the other hand he seized the tongue and drew it out of the mouth. This manœuvre was followed by a violent inspiratory movement and by the expulsion of a quantity of fluid. This process of rhythmical traction of the tongue was kept up regularly, and breathing set in slowly to begin with, but steadily. At the same time applications to the region of the heart and anterior portion of the chest were made with a towel dipped in extremely hot water. After persevering for half an hour some very feeble heart-beats could be detected. Finally, at the end of an hour the breathing and circulatory functions were re-established, the eyes were normal, but

rception and consciousness were not yet restored. It was not until ten clock in the evening—that is to say, at least four hours after the ordinary nctions had begun acting again—that the patient seemed to recognize ersons once more and to realize his situation.

"A curious fact connected with the case is that all recollection of what ad taken place from the time the person started out fishing was absolutely ffaced. There was a complete lacuna in this man's mind on this subject, nd his condition is the same at the present time—that is to say, ten months fter the accident. On a former occasion, in 1890, M. Laborde succeeded in bringing to life a woman who was apparently drowned by having recourse to the above-mentioned process."

From these facts we readily perceive that by this unique method it is possible to restore consciousness and life to a person apparently drowned. The effectiveness of the Laborde method of tongue-traction consists in the powerful action which stimulates the base of the organ. This, together with the effects of the traction, excites the respiratory centre to reflex action. The most *telling* way of applying this method consists in pressing down the base of the tongue with a spoon, covering the fingers with a handkerchief or similar cloth to prevent the tongue from slipping, and then pulling on it without hesitation or fear. The number of tractions to be made are fifteen or eighteen to the minute, corresponding to the normal breathing.

External and Internal Signs of Drowning.—These are subject to variation according to the period of submersion and the interval after the body is removed. When the body is recovered two or three hours after the drowning, and the examination proceeds at once, the skin will be found to be cold and pale, occasionally presenting livid patches of discoloration, or contracted so as to assume the "goose-skin" (*cutis anserina*) appearance; the expression will be placid, the eyes half open, the eyelids livid, the pupils dilated; the tongue swollen, frequently indented by the teeth, and pressed forward. The lips and nostrils are usually covered with mucous froth, and the fingers may be torn and abraded. The hands frequently contain gravel or other substances seized in a convulsive struggle at the bottom. Casper and Kanzler consider the retraction of the penis a sure sign of death by drowning.

In addition to the above, there are occasionally observed abrasions on the corpse, especially on the hands. The presence of sand, gravel, weeds, etc., in the grasp of the hands serves to indicate that the deceased was alive when he first struck the water. The abrasions, however, might be the result of friction of the body against some hard or rough substance after death. The corrugation and maceration of the skin of the hands or feet is noticed in those cases only where the body has been immersed for several days. In such instances the skin will have assumed a livid, blue-gray color.

The face assumes a reddish or bluish-red coloration if the process of putrefaction has commenced before the removal of the subject from the water.

Cadaveric rigidity generally sets in rapidly in the drowned, so that when discovered the body is often stiffened out.

Tidy[1] states that "frequently portions of the scalp and lower extremities will be found wanting. No doubt such breaches of continuity would especially occur where contusions or wounds had been inflicted before death; but such a condition might result from the excessive action of water simply, more especially on parts affected by cadaveric softening of the tissues, while it may also be accounted for by the ravages of fish, or more especially of the crustacea. Respecting this latter cause, it may be noted that the edges of injuries so caused are usually sharp and well defined, while in cadaveric softening or simple water erosion the edges will be found to be softened and ill defined."

Internally the body presents few appearances which are characteristic of the mode of death. Among these the presence of mucous froth, occasionally stained with blood, and of a trifle of water in the trachea, appears to be of importance. The vascular injection of the mucosa of this canal is also noteworthy.

The brain may be hyperæmic, although Casper holds the reverse condition to be more common. When present, however, it suggests a combination of coma and asphyxia. The position of the epiglottis, acccording to Kanzler, is always upright in cases of drowning; but, as a rule, this sign is of no value.

Congestion of the pulmonary arteries and venous system with dark fluid blood is not uncommon, although many cases are reported where the reverse condition was apparent. The larynx and bronchi are commonly found to be in a state of congestion, and of a cinnabar or vermilion color. Putrefaction causes the chocolate or darker shades. Evidence of emphysema may exist in or about the windpipe. The lungs are always more or less hyperæmic, and when incised may exude a bloody, mucous froth. They are distended and flabby, frequently overlapping the heart. The flabby condition is due to the taking in of water by inspiration during the struggles of the drowning person for breath. The existence of this froth, together with the sodden condition of the lungs, is considered a sure sign of death by this mode, although the absence of this condition by no means negatives the idea of drowning. Reese[2] mentions the case of the body of a woman recovered from the Delaware River in which these signs were absent, as well as the characteristic froth in the minute bronchial tubes. The same authority, referring to the Jennie Cramer case, says that the absence of these same peculiarities in the lungs of the deceased led many to believe that the death was not due to suicide by drowning, but that the girl was murdered before the body was consigned to the water. The subsequent discovery of a considerable amount of arsenic in the body of the deceased was, of course, sufficient to account for the cause of death. The presence of water in the

[1] Op. cit., p. 222. [2] Op. cit.

gs is strongly suggestive of submersion during life, and of death by hyxia.

The stomach and intestines are often much discolored. Important evi-ace is sometimes derived from the discovery of water in the stomach of e deceased. It appears to be swallowed previous to death; since, after ath, the apposition of the walls of the œsophagus prevents the entrance water into the stomach. If putrefaction has advanced to a great extent, ater may find its way into the organ after death. If fragments of weeds, nd, etc., are found in the stomach along with the water, the value of this sign greatly increased. In cases where either syncope or apoplexy occurs at the me the body strikes the water, the latter will not be found in the stomach.

The condition of the heart is not characteristic of this mode of death. In ost cases the right cavities are full of blood and the left ones empty, as in as-hyxia generally. Occasionally both sides are equally congested with blood.

The deep violet color sometimes noticed in the lining membrane of the omach and intestines of bodies long submerged might create a suspicion f irritant poisoning. The liver, spleen, and kidneys are usually full of lood. Bloody urine is occasionally found in the bladder.

Time of Submersion.—*How long has the subject been submerged?* 'o determine the time of the submersion of a body since the act of drown-ng is not always possible. Putrid decomposition is the principal obstacle. Reese[1] says that the most certain means for judging are "the presence of mucous froth in the air-tubes and cells and the presence of water in the ung-tissue, both of which indications disappear after exposure to the air and after putrefaction." M. Devergie's conclusions are as follows. For the irst three days during the *winter* there is but little change. From the third o the fifth day cadaveric rigidity is present; the skin of the palms of the hands begins to whiten. From four to eight days suppleness of the limbs exists, although they still retain their natural color; the palms of the hands are very much blanched. From eight to fifteen days the otherwise pale face becomes red in places and bloated, while the skin on the back of the hands and on the feet is blanched; a green spot appears at the base of the sternum. In one month the face is of a reddish-brown color, the eyelids and lips greenish and swollen, and the hands and feet appear very white and in folds; a reddish-brown patch, encircled by a greenish zone, exists on the front of the chest. At two months there is swelling of the face, which is general; the skin of the hands and feet is to a great extent softened and detached; hair falls out; but the nails are still adherent. The color of the face is brownish. In three months saponification commences, especially in women, about the face and neck, breasts, groins, and thighs, and the nails are loosened. In four months saponification has progressed on the face, neck, and thighs, and also in the brain; there are also general softening and destruction of the hairy portions of the epidermis.

[1] Op. cit., p. 182.

In *summer* the following allowances must be made : "five to eight hours' continuance in the water in summer are equivalent to three to five days in winter ; twenty-four hours in summer are equivalent to four to eight days in winter ; four days, to fifteen days ; and twelve days, to one month, or six weeks."

How soon after death by drowning will a subject float? The reply to this question depends upon various circumstances,—viz., the variation that exists between the time and the temperature of the atmospheric air, the water, the age and sex of the subject, the corpulence of the body, etc. In summer the body may float within twenty-four hours. Again, it will rise to the surface of the water more rapidly in salt than in fresh water. Bodies float more readily in shallow than in deep water ; very fat bodies sooner than lean ones ; and the bodies of young children and women sooner than those of adult males. Tidy[1] says, "In this country (England), as a rule, a body floats after from five to eight days, the water itself acting as a means of preventing the contact of air with the body and the presence of light, both of which conditions favor putrefaction. Further, the water serves to maintain the body at a temperature somewhat below what it would have if exposed to the air." The following table is from Tidy's "Legal Medicine."

Cases observed.	Hours after the Accident at which the Submerged Body or Bodies rose to the Surface.	Post-Mortem Appearances.
3	87 (= 3.5 days).	Bodies covered with sand and mud ; hands and feet sodden ; face and neck livid ; hair perfect.
1	95 (= 3.9 days).	Body covered with sand and mud ; hands and feet sodden ; face and neck livid ; hair perfect. (One eye had been eaten by fish.)
1	95 (= 3.9 days).	Face and neck decomposing rapidly.
1	100 (= 4.1 days).	Much decomposed ; hands sodden and peeling off. (The feet were protected by boots.)
1	112 (= 4.5 days).	
1	136 (= 5.5 days).	Much decomposed. Could only be identified by the clothes.
1	184 (= 8.7 days).	Decomposing but fairly preserved. Hair nearly entirely off the head ; the cuticle of the scalp peeling off.

Accidental, Homicidal, and Suicidal Drowning.—Drowning is rarely homicidal, except in the case of infants. (*Vide* Infanticide.) It is

[1] Op. cit., p. 228.

isually accidental or suicidal. *Was the drowning accidental, homicidal, or uicidal?* Tidy says, "Speaking generally, we may say, given the absence f any marks of injury, or given the presence of marks which may either e self-inflicted, or be caused by the water itself, or by objects in the water, e question we have suggested is one almost impossible to answer."

In the presence of lesions it is extremely difficult for the medical examiner ascertain whether the existing wounds were occasioned by the violence flicted by an assailant or were the result of accident. Marks of violence, ich as stab-wounds, gunshot injuries, a ligature about the neck, etc., sugest homicide.

Accidental drowning is sometimes very difficult to distinguish from those ses due to suicide; hence the importance of noting the circumstances atnding the various cases. Alcoholism is an important factor in cases of ibmersion due to accidental causes. The finding of a body in very shallow ater, while suggestive of homicidal drowning, is not inconsistent with accient, for the drowned subject might have been intoxicated at the time of the ccident, or the case might have been one of suicide.

Did the injuries occur before or after death? Dislocations, fractures, tc., frequently result from the contact of the body with the surface of the ater; for example, by jumping[1] or falling into the water from a great altiude. Again, the body of the person may be severely injured if it strikes he bank of a stream, posts, rocks, etc. Or, again, wounds may occur as he result of the force with which the body is propelled along the stream, s where it comes in violent contact with blocks of ice, rocks, boats, etc. These latter injuries may be either ante or post mortem. Ante-mortem wounds may be the result of shark-bites; the same holds true regarding post-mortem injuries.

Rosse says[2] that "self-inflicted wounds rather suggest *suicide*, as numerous instances attest, where one or two kinds of death were intended to make assurance doubly sure. I once saw an Esquimau stab himself and then jump overboard from a ship off the Siberian coast. But, as a rule, suicidal drowning is unaccompanied by traumatic lesions, unless it be those produced by falls. Hence the absence of lesions leads to the presumption that the individual while living fell into the water or other fluid accidentally or voluntarily. Exception may be made in the case of infanticide and *homicidal* submersion as the result of surprise, where a person taken unawares is suddenly and unexpectedly pushed or thrown into the water. A case in point is that of a man suddenly robbed and seized by three persons, who threw him into the river. Another is that of a man who, wishing to get rid of his wife, gave her arsenic. The effects of the poison being slow, he induced her to

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[1] The post-mortem examination in the case of Professor Odlum, which was made by the writer, revealed rupture of almost every organ in both the abdominal and pelvic cavities. Odlum was the first man killed by jumping from the Brooklyn bridge.

[2] Op. cit., p. 809.

take a walk along the river, and when her back was turned he pushed her rapidly off the bank into the stream, where she drowned. Death by submersion is rarely the result of murderous intent, and in the case of adults it is suddenly resorted to in order to paralyze resistance and facilitate the success of crime. . . . No single sign or post-mortem appearance is characteristic of drowning, and none enables us surely to diagnosticate death by submersion either in putrid or fresh cadavers. Nor do we have any significant infallible signs that may serve as a parallel between the immersed post mortem and the submerged. The exterior signs being nearly the same in the two, the diagnosis must necessarily depend upon assembled circumstances, and these are liable to vary."

CHAPTER XXXI.

THE MEDICO-LEGAL ASPECT OF ELECTRICITY.

Remarks—Resistance of the Human Body to Electric Currents—Symptoms produced by Powerful Discharges of Electricity—Methods for Resuscitation from Electric Shock—Death from Electricity—Post-Mortem Signs—Electrocution—Lightning.

THE universal interest evinced by scientific persons regarding the applicability of electricity to the needs of mankind is scarcely commensurate to that occasioned by the abnormal increase, within recent years, of electrical accidents and injuries due to the ignorance displayed by those whose duties ought to require of them greater familiarity in the application of so dangerous an agent. As the multiplicity of these accidents is on the increase, and as the properties of electric currents should by this time be thoroughly familiar to those engaged in electrical manipulations, the task of fixing the blame ought not to be a difficult matter. Occasionally these accidents are entirely the result of carelessness on the part of the victim himself, while, on the other hand, they may follow the employment of imperfect apparatus or poorly insulated conductors. Again, the blame may attach to the subway or power-producing companies, or to those who unnecessarily expose their employees to the dangers of questionable apparatus.

Electricity is employed nowadays for electric railways, electric lighting, heating purposes, medicinal purposes, and other analogous objects. What present and future investigation, experiment, and knowledge will bring forth remains problematical; but from present indications, which, perhaps, may be but temporary or provisional, the utilization of electricity for economic purposes bids fair to be realized. So exhaustless is the study and so doubtful and subject to dispute are some of its most prominent questions that to discuss them would entail an unnecessary play of words. Such rapid advances of knowledge in this direction require a more substantial basis of fact ere comprehension of the many details can be learnedly subjected to dis-

ssion in a book such as this is; hence this article will only embrace those cts which have been satisfactorily ascertained as the result of multi-experiental research, and which are of medico-legal interest.

As the subject of atmospheric electricity (lightning) will be discussed arther on, in a separate article, the present dissertation will be limited to he effects caused by mechanical or artificial electricity.

Persons are not infrequently seriously and even fatally injured through the effects upon their bodies of currents of high tension. These results are occasioned by some *false play* of the current during its transit from its point of origin,—the dynamo or storage battery. When such a current—diverted from its normal course—comes in contact with any portion of the human body, accident or injury is sure to follow, the effects, of course, depending as to their severity on the degree of strength expended by the current. Sometimes the accident results from the direct contact of the person with the storage battery or dynamo, or by the contact with various objects which of themselves possess the power of conducting the electric fluid when accidentally in contact with portions already charged. Thus it happens that electric wires are frequently the cause of serious accidents, since all that is required for the result is the contact of a readily conducting object, whereby the injury is effected. Bullard[1] mentions the case of a young clerk who, while raising the metal-edged cover of a show-case in a store, accidentally brought it in contact with the charged wires of an electric light with fatal results. The most frequent cause of electrical accidents is the improper or imperfect insulation of both the transmitter of the current and the terminals, such as wires, etc. Again, accidents not infrequently occur from the improper position of the transmitters and terminals with regard to other objects which themselves possess the power of conducting the electric fluid. Great danger will always be prevalent so long as the present system of hanging wires or other conducting objects overhead exists; for it is not always possible to effect proper insulation. Even were it a possibility, the displacement of transmitters, etc., through the intervention of storms and other accidents must not be lost sight of. Bullard,[2] on the other hand, says, "It must not be supposed, however, that underground electric wires or transmitters cannot produce accidents. On the contrary, the current may be diverted from them to gas- or water-pipes, or to any other conductors which come into contact with them, or can attract to themselves a portion of their current. Severe shocks have been experienced by persons attempting to draw water at their faucet from causes of this character."

The employment of electricity at the present time as a motive power is well exemplified in the trolley system of cars; and here the danger of accidents would not be so great were the transmitters or overhead wires securely fixed in their support, insulated with care, and properly protected

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, p. 666.

[2] Op. cit.

from the influences of the elements. The same principles also apply to telegraph and telephone wires, etc.

Indirect accidents are among the effects of the receipt of a severe shock. They are present in the form of fractures, luxations, wounds, or, in fact, almost any form of injury. They are readily accounted for, being the result of insensibility or of involuntary contractions of the muscular system while the victim is in a dangerous position. Thus it is that linemen, etc., are so often seriously and even fatally injured by being hurled to the ground or to a great distance from their previous position after having received an electric shock emanating from the contact of a "dead" with a "live" wire, etc. The medico-legal importance of this class of injuries relates only to the fact that they are the result of an initial shock; otherwise, they are of no importance to the legal physician, and are to be treated as other accidents similar in kind but of different etiology.

Direct accidents are the result of the immediate effects of the electric fluid. The symptoms may be either instantaneous or protracted, varying according to the constitution of the victim, the strength of the shock experienced, and the portion of the body affected by the electricity. The symptoms may also be slight or severe according to whether the effect of the electricity be the result of a constant or an interrupted current. Shock, which is always the source of danger, is experienced immediately, in constant currents, at the moment the circuit is released or closed, while in the alternating currents it is occasioned also by similar procedures.

Faradic currents are developed by induction from the galvanic current. This form of electricity is seldom employed in the arts. Its first effects upon the body are of a stimulating character,—that is, it affects the muscles by excitation, finally tetanizing them. So frequent in their succession are the shocks by this electricity that they are scarcely appreciable as being distinct and single. *Frictional* or *static electricity* rarely causes severe injuries or death. It is seldom used mechanically.

The effects of an alternating current of electricity are greater and more serious to the human body than those occasioned by a current permitted to pass through the system uninterrupted. As has been pointed out already, the shocks experienced only at the time of opening and closing the circuit are somewhat different in their degree of strength, the stronger shock following the reversal of the machine. Therefore, a person coming in contact with this form of circuit is likely to receive a full shock, the latter being vastly intensified according to the number of reversals made.

Burns of greater or less degree are frequently the result of electric currents. They are usually situated about the hands and feet on account of the frequency with which these members are brought into play during electrical manipulations, such as the handling of wires, etc. If the skin of the member affected be in a moist state, the burns are apt to be severe, due to the ease with which the conduction of the fluid is effected. They are usually deep and followed by sloughing, although the presence of surgical shock is

t constant. They are tardy in healing, and are occasionally attended by ralysis and anæsthesia of the arm, etc., due to shock.

Resistance of the Body to Currents.—The resistance of the human dy to electric currents varies (1) according to the different resistances fered by different persons, and (2) according to the variable resistance ten presented by the same tissue of the same body. Thus, a few months go a man received a shock from a 3000-volt[1] electric current, and was ccessfully resuscitated by the application of artificial respiration; while nother accident, which proved fatal, was caused by a current of but three undred volts. Therefore, it is almost impossible to draw the line between ose conditions of the body favoring resistance to the current and those cilitating its entrance.

The greatest resistance, however, is offered by the epidermis, and when he latter is in a perfectly dry state it is impenetrable to even strong currents. Jolly,[2] who measured the different epidermic surfaces of the human ody as to their powers of resistance, found the latter to be from 40,000 down o 15,000 in males and to 8000 in females. Other observers computed it as rom 80,000 down to 3000 ohms. Of 236 men, the average resistance registered 1184 ohms, varying from 1870 to 610 ohms, the site of the measurements being the hands, which had been previously washed in soap-water and ubsequently dipped into a solution of caustic potash. The battery employed was a four-cell chromic acid one, each cell possessing an E. M. F. of two volts. Other experiments on human beings, from the age of eleven to fifty-one years, were carried on at the Edison Laboratory in 1889. The resistance measurements were ascertained between the hands; and of 259 males, 986 ohms was the average result, with variations of from 1970 to 550 ohms. The hands were treated with the caustic potash solution, as in the above-mentioned experiments, but independent of polarization. (Bullard.)

The powers of resistance shown by various animals depend on the conductility of the skin, or they may vary according to the nature of the animal. Bullard[3] says that "the variations between the resistance of similar animals, according to the condition of the skin at the time of the experiment, are much greater than those which are found between animals of different species under similar conditions, or which are referable to specific susceptibility."

Resistance diminishes according as the current increases, and the effects of great shocks differ in proportion to the amount of resistance offered. If the resistance presented by the epidermis be small, the current will without difficulty effect an entrance; but if the resistance be great, although its force is but momentary, the phenomena of burning and charring of the parts will be presented. (*Vide* Electrocution.)

[1] The following definitions are subjoined. A *volt* is the unit of electric pressure or electro-motive force. An *ampère* is the unit by which the current-strength is measured. An *ohm* is the unit of resistance offered to the passage of the electrical current. *Siemens's unit* is to the ohm as 1.06 to 1.00.

[2] These measurements were in Siemens's units.

[3] Op. cit.

Symptoms of Powerful Discharges of Electricity.—(*Vide* also Electrocution.) These may be described as occurring under three headings: (1) mechanical symptoms, (2) internal symptoms, and (3) mental symptoms. Of the first class (mechanical), those of burns[1] are the most common and important. These usually appear at the points of entrance and exit of the current, although they are possible in any other region of the body. They are severe according as the skin is in a dry or damp state. The following case, quoted from Hamilton's "System of Legal Medicine," is a characteristic one. "Electric shock. Fall from pole. Severe burns from electric-light wire. Sloughing of burns, gradual failure, and death.

"Peter K., aged nineteen; single; born in Ireland; a lineman. Some alcohol; denies syphilis. At 2 P.M. on November 17, 1886, while on a pole trimming an electric light, was severely burned, and fell about twenty feet. Had no recollection of the fall or how he struck. Considerable shock. Well developed and nourished. Right wrist burned superficially over a space about three inches each way. Right thenar eminence burned through to the muscles, and adductor pollicis laid bare over a space the size of a quarter of a dollar. Middle finger burned to the bone over a space about two inches long, beginning at tip of finger and on the back of it. Little finger burned the same as the third. Two middle toes on right foot burned a little. Poultices to burns. Two wounds of forehead over right eye, each about three-quarters of an inch long, and one of them just over the border of the orbit. Large subconjunctival hemorrhage in left eye. Both wounds stitched with catgut and sealed up with absorbent cotton and compound tincture of benzoin, after being powdered with iodoform. Brandy, ♏xxv, and Magendie's solution, ♏v, subcutaneously; heaters. November 19, on dangerous list. Poultice has made burns much less painful. Little finger of left hand has turned completely black. Sloughs on right hand are deeper and are separating out. Arm swelled to elbow. To-night he feels miserably, and says he felt a repetition of the shock of the electricity at four o'clock this afternoon, the time of the accident, or very near it. Still on the dangerous list. November 25, has been delirious for some days. Pulse and temperature up. Very sick to-day and failing fast. This afternoon was constantly muttering to himself. Pulse getting weaker and weaker. Takes brandy, a teaspoonful at a time. Sloughs on right hand very deep and foul-smelling. Little finger of left hand entirely dead. Died at 4.45 P.M." (Reported by Dr. Galvin, Boston City Hospital.)

Another effect of currents of electricity is muscular contraction. When the electric stimulus is strong, the contractions are tetanic in character and of a continuous nature, visible until the force is discontinued. Thus it is that those members of the body in contact with a wire or other conductor are so forcibly contracted that it appears well-nigh impossible to undo the involuntary act by any voluntary effort. By reason of this linemen are often severely

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[1] *Vide* p. 392.

burned about the hands and arms, and it necessitates the employment of great force to release such persons from their dangerous position. Direct accidents frequently follow as effects of this strong involuntary muscular contraction; persons are often suddenly released and violently thrown for quite a distance, injuring themselves seriously and often fatally. A rare complication of this phenomenon is the rupture of the tendons or muscles, and in exceptional cases fracture and luxation of the bones.

The *internal symptoms* following a severe shock of electricity are subject to variation. In some cases no essential or internal signs are shown other than the discomfort following a burn or burns. In other cases the patient complains of vertigo, flashes of light before the eyes, or a sense of impending danger. Insensibility may ensue, but in less severe shocks it may be but partial or entirely wanting. Occasionally a general tremor follows the shock, lasting from a few hours to several days. Clonic rhythmical spasms of one or more of the extremities are observed in severe cases. It is not infrequent for collapse to follow the insensibility, particularly if the latter be complete. This is shown by the excessive perspiration, pale countenance, feeble heart-beat, and coldness of the limbs. In the great majority of cases, however, the following conditions prevail during the stage of unconsciousness: face cyanotic, pupils in a state of dilatation, respiration stertorous or absent, pulse full or feeble, or scarcely perceptible, or the condition is followed by delirium. The shock may be instantaneously fatal, or, if treatment be prompt, consciousness may be the initiatory step to complete recovery. In other cases the insensibility is lasting. The secondary results of the shock, irrespective of any injuries that might be inflicted, may resolve themselves into those which are slight and of but momentary importance, or into those which are serious and protracted or even fatal in their effects. Mental phenomena are apparent when the secondary results of shock occur, aside from injuries, as effects of motor or sensory changes. Of the motor changes, there is weakness of the body and limbs, together with tremor and unsteadiness of the extremities. The sufferer may show rhythmical movements of several or all of the extremities, followed by those which are limited to the parts implicated by the current of electricity, such as are occasionally observed in hysteria and other like conditions. Pain may follow any voluntary effort on the part of the patient to control such movements.

The sensory effects of electric shock are evidenced by sensitiveness in the affected part. This may be hyperæsthetic at first, and if prolonged or succeeded by a diminution of the sense of feeling, aside from traumatism, it may appear as a psychical rather than an essential or internal symptom. The pain that occurs subsequent to the restoration of sensibility is of a darting, sharp, neuralgic character, particularly experienced in the affected part.

Other symptoms of minor importance that occur prior to the loss of consciousness are a metallic taste in the mouth, tinnitus aurium, nausea and vomiting, and a sense of dizziness or vertigo. The breathing is generally rapid at first in severe cases, or it may cease altogether (*supra*).

The *mental* or *psychical symptoms* following shocks of electricity are mostly of a functional order, and are quite like those experienced by persons as a result of railway accidents (injury to the brain and spine); in other words, they are traumatic functional neuroses. "These conditions," says Bullard,[1] "are so well known when produced by other causes that we do not consider it proper to enter into a full consideration of them here, but we cannot leave this important subject without a few general remarks. No form of affection or disease has caused more discussion among the medical profession or figured more prominently in the courts than this, and even now there are many questions in relation to these conditions still under dispute. Our own view, confirmed both by observation and experience, is that the tendency in New England, at least, has been on the whole to underrate the severity, the duration, and the amount of suffering caused by these conditions. That because there have been cases of malingering, of deception, and of rapid cure after the receipt of damages, and because in addition to this a certain visible emotional and at times apparently controllable element exists, the profession, and above all the laity, are led to conclude that this forms the essential condition and basis of the disease. On the contrary, in a very large proportion of cases the symptoms are such as cannot possibly be voluntarily assumed; they produce extreme discomfort and often much suffering for the patient, and frequently last for years, rendering their victims incapable of carrying on their former occupations. Fortunately, in the patients suffering from electric shock the severer forms of these affections are not so common. In most of the cases reported recovery has been more or less rapid. Cases in which previous hysteria or neurasthenia has existed are more liable to these manifestations than persons of a previously equable nervous constitution, but these latter are by no means wholly exempt. To consider these conditions, as is sometimes done, as the fault of the patient seems to us both unwarrantable and unjust." (*Vide* Lightning.)

Methods for Resuscitation from Electric Shock.—The first aid in electrical accidents may be summed up roughly in the following procedures. If the means are at hand, and the rescuer understands how to do it, the current should be arrested at once. If this is not practicable, care should be taken not to touch the patient's hands or face, or, in fact, any naked part of his body. If no India-rubber gloves are at hand, the patient should be dragged away from the wires by grasping the clothing, such as the coat-tails, or after throwing a blanket or coat around him. A dry cloth may be employed for this purpose, when the sufferer may be dragged away by being grasped through it. When it is impossible to remove the injured person from the wires, that part of the body that is in contact with the earth or the wire should be raised from it, using the insulated or covered hand. This will produce a break in the current, when it will generally be possible to remove

[1] Op. cit., p. 689.

[th]e body. If this is found impracticable, a dry cloth should be so placed as [t]o be between the sufferer's body and the ground; then the attempt should [b]e made to disentangle the body from the wires. It is also well to recollect [i]n connection with these accidents that wood is a non-conductor, and that [a] stick of it may be used to draw the body over to one side, or to hold back a charged wire (live wire). To remove a person from the ground, or off a cross-piece, such as a telegraph-pole, a piece of wood should be passed under the heels, in order to lift him up, when the feet are to be immediately raised. After any of these procedures have been resorted to, the patient should be carried to a suitable place, where the atmospheric air has free access, in order to commence the work of restoring the function of respiration. Persons not directly concerned in the welfare of the patient should stand aside or be dismissed from the place. The body is then placed upon the back and all the clothing removed from the neck and chest, and treated as one drowned. A rolled coat or other convenient article should be placed under the shoulders, in order to give support to the spine and cause the head to drop backward. The operator then takes a position behind the patient's head, so as to face him. He then proceeds with any of the well-known methods for effecting artificial respiration. At the same time an assistant should forcibly open the mouth, remove any foreign matter, etc., and grasp the tongue with a cloth. (*Vide* Treatment of Drowning.) The mechanism of this operation consists in the stimulation produced on the sensory nerves and the reflex action on the principal motor nerves distributed to the muscles of respiration. The first result of these tractions upon the tongue is the return of the contraction of the diaphragm. Feeble movements are then noticed extending upward to the thoracic region, and, finally, the action of the muscles of the neck, face, nose, etc., becomes apparent.

The first part of Dr. Peter J. Gibbons's method of resuscitation is essentially the same as that just depicted. He says that the two prime indications in the treatment of those electrically shocked are, first, to restore the respiratory function, and, secondly, to promote warmth and circulation. "When an electric-shocked person is found, he must be treated on the spot and in the open air. On no account waste precious time by removing him to a house, unless the weather is intensely cold. Secure a return of breathing, first protecting him from the severe cold by coats, blankets, etc., if necessary. . . ." After resorting to any of the methods indicated above, the operator must recollect that there is no water to be expelled, as is the case in drowning accidents. If any of the methods of resuscitation, such as Sylvester's, prove futile, Gibbons advises the insertion of the distal end of the tube of his apparatus[1] into the nostrils or the mouth, preferably the former. "In this

[1] Dr. Gibbons's apparatus consists of "a simple double bellows, so constructed [t]hat when the handle of the bellows is raised the air rushes from the patient's lungs [i]nto one apartment of the bellows; simultaneously the other apartment is filled with

way the air, during inspiration and expiration, comes in contact with the lining membrane of the nasal chambers. In doing so it allows the membrane to carry out its normal physiological action, and by this means we get so much nearer a normal respiration. The air thus breathed is both warmed and saturated to a certain extent with watery vapor, and much of the dust and other foreign matter floating in the air is removed by adhering to the moist mucous membrane. The nostrils should be excited with snuff, hartshorn, and smelling salts. This can be readily done without the removal of the tube by allowing the exciting agent to enter the bellows with the fresh air or oxygen.

"*To restore Circulation.*—The above measures are directed wholly to restoring the breath. This is the first necessity. There should be no rubbing of the surface while this is going on. Should the inclemency of the weather demand the removal of the patient in-doors, the above movements must be kept up, even while he is being removed, and on no account should he be taken into a warm or crowded room. When the patient begins to breathe, commence rubbing the limbs. Rub them upward with considerable briskness and pressure. Use silk, somewhat warmed; throw a quilt or blanket over the patient, and continue friction under this. The friction in this way will create electricity and heat. Put warm bricks or bottles of warm water at the feet, between the thighs, and under the armpits, but be very careful not to have these things too warm, or much above the temperature of the healthy body. The above rules are for laymen. Physicians may insert the distal end of my apparatus through the mouth, into the laryngeal entrance, as they would introduce a tube for intubation of the larynx. Some will probably find it more convenient to do tracheotomy, and insert the tube into the trachea. He can also use electric batteries to keep up body heat, body electricity, and to excite the heart and lungs to action. My method, or any other used, should not be discontinued for at least three to six hours, and the operator should not be discouraged if he sees no symptoms of returning life until this amount of time has elapsed. Why no symptoms of life are seen for one or two hours and may be shown later I shall not attempt to explain, but such is the case in my experience. Before giving up all hope I recommend the injection of an alkaline solution into the body, such as has been tried upon people who have bled to death. When we cease artificial respiration, nature may refuse to perform its duty, and we might be obliged to resort to the artificial method again. Sometimes it is necessary to carry on artificial respiration from ten to forty hours after life has been restored. During this time we might test nature four or five

fresh air through a tube on the reverse side. This air is forced into the lungs by the compression of the handles. The apparatus is designed to resuscitate people who have undergone electrical shock, taken poison, been long immersed in water, pressure on the centre of respiration, or have suffered from similar misadventures. The instrument is designed to restore suspended animation expeditiously and more certainly than any method now in use."

mes, and find it not able to be self-sustaining. Therefore we should keep p the artificial aid until that time arrives when nature will perform its nctions." (Printed for the Royal Canadian Humane Association, Toronto, 895.)

Death from Electricity.—Goelet says that death from electric shock may be produced in one of two ways,—viz., either (1) by causing destructive tissue-changes when the death is absolute, or (2) by producing instantaneous stoppage of the respiratory and heart muscles through excitement of the nerve-centres when death is only apparent (suspended animation). He further says that, strange as it may seem, the alternating current of electricity, which is usually considered the most dangerous and fatal, almost always causes death in this second manner. Therefore, according to this reasoning, electricity seldom destroys life immediately, but, if the suspended animation be not counteracted, death naturally follows.

If the current has actually produced destructive tissue-changes, the objective appearances consist of an instantaneous production of tetanic spasms of the muscular system during closure of the current, which relax with current opening. In other cases, such as of electrocution, clonic muscular spasms of the thorax were noticed; also immediate loss of sensibility, pallor of the face, dilatation of the pupils, dimness of the cornea, mucus from the mouth, purple spots in the skin of the face, and cessation of the pulse.

In these cases death is immediate, or nearly so. Kratter, of Austria, believes that the danger of shock from strong currents of electricity for the animal organism appears to increase in degree with the higher development of the general nervous system. Hence his explanations of the fatal results to man by currents which in no way affect some of the lower animals, although both electrodes be secured to the head. Where death did occur in lower animals, such as guinea-pigs, dogs, cats, etc., his experiments elicited the fact that it resulted principally from the instantaneous stoppage or primary cessation of the function of respiration. The functional disturbance continued in some instances a sufficient length of time after the end of the irritation to cause fatal results by suffocation. The heart's action was maintained during this period of asphyxiation; but if the breathing was allowed to cease for a period of about two minutes, secondary cessation of the action of the heart ensued, the same as in cases of mechanical suffocation. In other cases the animal would spontaneously commence to respire again, and even recover entirely.

The following case is reported by Dr. Buchanan.[1] The victim, a few minutes after having received the electric shock, which proved fatal, presented the following symptoms: the face was livid, the lips hyperæmic, the pupils dilated, mucus mixed with blood flowed from the nostrils, and the hands were almost clinched. He was discovered lying upon his back, inclined to the right side. Means of resuscitation were resorted to, but without

[1] Lancet, vol. i., 1892.

avail, and after three gasps he died in four minutes, the body being in a state of rigidity. No external marks were observable either upon the head or body. There was, however, a dark spot on the right hand, probably occasioned by the japan from an iron bar which he held in his hand at the time of striking at the induction wire while the insulating india-rubber was fusing. After having struck the wire he instantly fell back, uttering at the same time a cry for help. He was then carried away unconscious. (*Vide* Electrocution.)

Post-Mortem Signs.—These are not constant, nor are they indicative of death by electricity. Rigor mortis is usually found in these cases. The internal organs may be considerably congested, but aside from this there are no significant changes produced by the current. Grange reports a case where the heart was found engorged with liquid blood having a rosy vermilion color, which became of a darker hue on exposure to the atmospheric air. In a case recorded by Matzinger he discovered liquid blood, but of a black color, the red and white corpuscles being perfectly normal; there was no evidence of fibrin. In electrocution cases nothing of importance is found, other than occasional petechial spots beneath the pericardium and underneath the pleura. (*Vide infra.*)

Bullard:[1] "There seems to be no evidence that the bodies of those dying from electricity in any form suffer unusually rapid decomposition. . . . The only absolute sign of death from electricity is decomposition of the tissues, but the usual signs are to be relied upon to the same extent as in ordinary cases of death."

The following cases of electrocution (post-mortem appearances) may be of interest in connection with this subject. The autopsy held on the remains of Jugigo, the Japanese murderer, was conducted by Dr. Van Giesen, of New York, and is described as follows by Dr. MacDonald.[2] "The post-mortem examination was held four hours after death. The pupils were alike and moderately contracted. The body was well nourished and unusually well developed. The anterior epithelial cells of the cornea had desquamated from the central portion by the action of heat. There was a bulging forward of the sclera of the left eye at the left sclero-corneal junction. Conjunctiva anæmic. The scalp and the skin covering the neck had a dull, purplish hue. The skin of the anterior surface of the body was not discolored or ecchymosed. At the flexure of both elbows were a number of symmetrical linear ecchymoses, which were more marked on the right side; also a curved, narrow ecchymotic line just below the right nipple. These were probably caused by the straps. At the posterior surface of the right knee-joint, and on the posterior and inner and upper surface of the calf, the epidermis was raised, wrinkled, and folded. At the flexure of the knee-joint the epidermis had been torn

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[1] Op. cit.

[2] The Infliction of the Death Penalty by Means of Electricity. D. Appleton & Co., New York, 1892.

away to the extent of about an inch in diameter. The right lower extremity was flexed and bent more to the median line than its fellow. There was a slight discharge of thin, milky fluid from the urethra, and some still remaining in the canal. A sample of this fluid was taken for microscopical examination. Post-mortem rigidity well marked, except in the arms, where it was only slight. The whole posterior surface of neck, trunk, arms, and lower extremities was of a dull, purplish hue. There were a few slight blisters on both temples and both cheeks and eyelids. There were raised whitish streaks on both sides of the neck, just below the angle of the jaw. The trunk was opened by a straight incision from the top of the sternum to the pubes. The fat was an inch thick over the abdomen. Muscles red and firm. Diaphragm at left side was found at the level of the sixth intercostal space, and on the right side at the fifth intercostal space. Portions of small intestines were taken for microscopical examination. Examination of heart: auricles and ventricles flaccid and in diastole, and filled with fluid blood. The larger vessels were tied and the heart removed. The left ventricle was well filled with fluid blood, but no clots. The auricles were the same. The blood was of the same color in the left ventricle as in the right. Valves normal. On opening the vessels a large quantity of dark-colored liquid blood escaped, half filling the pleural cavity. There were no pleural adhesions. Lungs perfectly healthy, but slightly congested. The spleen was found to be of normal size, the capsule smooth, pulp firm and uniformly filled with blood, and the arrangement of the Malpighian bodies and splenic connective tissue entirely normal. The pancreas was perfectly normal, and a portion removed for microscopical examination. Liver entirely normal, and a portion was also removed for microscopical examination. The gall-bladder was filled with bile. Left kidney: the capsule was non-adherent. It was rather large, and the cortex of normal thickness. The kidney was uniformly injected, and the markings in the cortex were normal as to number and arrangement. The right kidney was in the same condition. The stomach was empty, the mucous membrane pale; the rugæ were well marked and perfectly healthy. The intestines were healthy. The small intestines were filled with semi-fluid fæces. The large intestines showed the same condition. The urinary bladder was normal and half full. Examination of brain: the brain was exposed by a straight incision of the scalp over the vertex from ear to ear, and saw-cuts through the skull at a slight angle and at the level of the eyebrows. The scalp showed several old scars, and was slightly less adherent under those portions where the electrode was attached. The skull was symmetrical. The dura mater was normal and the vessels moderately dilated. The longitudinal sinus was found to be normal and contained some fluid blood. The brain was removed in the usual way. The pia mater was uniformly thin and transparent; the vessels in a medium state of congestion; subpial fluid small in amount. The blood was everywhere fluid in the meshes of the pia mater. There was no apparent difference in that portion which the electrode covered. The vessels at the base were perfectly normal.

The ventricles contained a small amount of clear fluid. The roof and floor of the lateral ventricles were normal. The ependyma was smooth and transparent. White substance firm. Gray matter normal in every respect. Floor of the fourth ventricle at the upper half contained some dilated vessels, and on the left side there were a number of minute, radiating, petechial spots from one to two millimetres in diameter. The spinal cord was exposed in the usual manner. The external appearance of both cord and membranes was entirely normal, and the vessels contained, if anything, even less blood than usual, due, probably, to the short time that had elapsed between the occurrence of death and the holding of the autopsy. Sections half an inch apart showed nothing abnormal. A portion of both sciatic nerves was taken for microscopical examination. Owing to the great length of time necessary to make this autopsy as completely and minutely as was done, and the subsequent careful microscopical examinations, it was not considered necessary to examine the brain and spinal cord in the other cases, especially as nothing of any importance had been observed in these organs in this case. The microscopical examinations showed no recognizable changes in the tissues or organs of the body."

The post-mortem examination in the case of the negro murderer, David Hampton, who was electrocuted at Sing Sing Prison, January 28, 1895, revealed considerable ruptures of the cerebral arteries as a result of the current.

The autopsy on the body of Dr. Robert W. Buchanan, the wife-poisoner, who was executed by electricity at the above-mentioned prison, July 1, 1895, is reported by Drs. Irvine and Sheehan, the operators, as follows. "Body that of a medium-sized, well-nourished man; height, five feet seven inches; weight, one hundred and sixty-two pounds; age, thirty-two years. Very slight abrasion on right calf, and slight abrasion over left eye, both corresponding to application of electrodes. Head: veins and sinuses engorged with blood; convolutions and sulci about medium in depth and thickness; otherwise normal. Thorax: lungs normal, excepting adhesions in apex of left, and also calcareous deposits. All abdominal organs were healthy. Stomach half full of partially digested food."

Electrocution.—This is the mode of executing criminals in the State of New York. Considerable discussion has been evoked by scientific persons relative to this method, on account of the possibility that the condemned person might still retain a certain degree of consciousness after having received the electric shock, and to many the question has loomed up, *Does the electric current destroy life?* Several prominent physicians claim that the death of the victim electrocuted is not caused by electricity, but follows as a result of the autopsy or otherwise. In two or three cases, notably those of Kemmler and Taylor, death was evidently not instantaneously effected, and in the latter instance the sensibilities of many were horribly shocked. The execution of Taylor occurred at Auburn Prison, July 27, 1893. The terrible scene is thus depicted in Hamilton's "System of Legal Medicine," p. 368. "A current of twelve hundred and sixty volts was turned

on at a given signal, and with a crash the legs shot forward and upward, tearing the standard and entire front from the chair. For exactly fifty-two seconds this condition was sustained, and then the current was shut off. The condemned now pitched forward, and would have fallen upon his face had he not been restrained by straps. For twenty seconds he remained apparently dead, a slight froth oozing from the mouth below the mask; then gasped. An attempt was made to again turn on the current, but this failed. Pulse could not be felt. Thirty seconds later pulse was slight and thready; respiration 6 per minute. He was unbound and placed on a cot, and removed to adjoining room. Respiration now 12 to 13, pulse 100 and full, breathing stertorous, and features possessing the idiotic expression seen in apoplectic seizures. Breathing continued labored, but increasing in frequency, and at half an hour after contact was 18, and pulse 120 and full. He now made the first movement of left foot, and in a very few moments became restless, moving legs and arms and rolling from side to side. He was now given, hypodermatically, three-fourths of a grain of morphine. After fifteen minutes, no appreciable effect being produced, a cone was saturated with one-fourth chloroform and three-fourths ether, and applied. He opened his eyes and tried to object to this. Forty-eight minutes after contact pulse was 130, full and vigorous. Readily responded to the anæsthetic, and was again placed in the chair, and a second contact made and continued forty seconds. An examination proved him dead from a voltage of twelve hundred and twenty. Autopsy one hour and thirty-four minutes later: no rigor mortis; slight eschar on temple, extensive one on right side; slight congestion of peritoneum; lungs slightly congested at apex; one ounce serum in pericardium; otherwise normal conditions; blood fluid throughout." Commenting on this case, Dr. P. J. Gibbons, of Syracuse, New York, in a published interview, says, ". . . It was announced that the armature of the dynamo burned out, and that it was necessary to obtain current from the city lighting plant to complete the operation. Such was not the case. The armature burned out, to be sure; but when they applied the current the second time, fifty-three minutes later, they applied it to a dead man. Taylor came to himself sufficiently to move and talk and walk. Deadly drugs were administered to him, and he was killed by those drugs; and, as I say, when the borrowed current was applied, it was applied to a corpse, made such by the administering of deadly drugs. . . . I was in Auburn Prison when they killed the negro Johnson, about two months after the Taylor execution. After the current had been applied to Johnson, I was allowed to apply the simple means of artificial respiration, and did so. It was not very long before the condemned man gave a gasp and showed unmistakable evidence of returning consciousness. The warden intervened and prevented the further prosecution of the attempt, and a little later they performed the autopsy."

Professor d'Arsouval mentions the case of a man, picked up for dead, who was restored to his normal faculties after having received a voltage of

four thousand five hundred. The accident was due to the contact of the man's person with an electric wire. It was witnessed by Picou and Maurice Leblanc, and reported to the French Academy of Sciences. The accident is thus described. "A sudden sparking on one of the dynamos of the electric-light station of St. Denis, near Paris, indicated a short circuit on the line. The dynamo was quickly cut out and stopped. The voltmeter reading was four thousand five hundred volts between two wires, and the ammeter read seven hundred and fifty milliampères on the wire. The accident occurred at a place where the three wires were supported eighteen feet above the ground on a bracket fastened to a stone wall. The bracket carried several cross-pieces, and on the lowest one sat the laborer who had received the shock, holding the conductor with one hand. He had been sent up to fasten a telegraph wire, had touched the live wire with the wire he held, and thus short-circuited the current through his hand and back to the earth. The man had, therefore, received a four-thousand-five-hundred-volt current of fifty-five alternations per second, perhaps, for several minutes, and when he was found fully a quarter of an hour had elapsed since he received the shock. He gave no sign of life, and it took another half-hour to remove him from his perilous position and stretch him on the ground. The attempt was at once made to cause the lungs to act by moving the arms alternately up and down, but without avail. The mouth was then forcibly opened and the tongue was pulled out and allowed to recede. This being the best method of producing respiration artificially, the lungs actually began their functions almost immediately. Two hours later the man was able to speak. He had burns on his hand and back, but was otherwise not injured." These facts led d'Arsouval to declare execution by electrocution objectionable and of questionable effect. He maintains that the electric current simply produces a suspended animation, and that the individual subjected to it may be restored to consciousness and life by artificial respiration. Hence his conclusion is that the electric shock of the New York penal laws does not kill. These extraordinary statements, coming from a man of such world-wide renown, although seemingly incredible, bear the stamp of authority upon their face, and must, therefore, be accepted by the scientific world for what they are worth. The *Moniteur Industriel*, of France, publishes a summary of the labors of d'Arsouval on fatal accidents and those which do not end in death, produced by currents of electricity of high power.

Conclusions, pro and con, Relative to Electricity and the Death Penalty.—The following extracts from published interviews with prominent physicians and scientists will be of interest, concerning as they do the present mode of inflicting the death penalty in the State of New York:

". . . Notwithstanding the wide publication of the execution of Kemmler, and the efforts which have been made to proclaim it a failure and to invest it with an air of repulsion, brutality, and horror, it is confidently believed that when all the facts in the case are rightly understood, the first execution by electricity will be regarded as a successful experiment, and that

in time due credit will be accorded to those whose duty required them to act as principals in carrying out the law, establishment of which is destined in the not distant future to be regarded as a step in the direction of a higher civilization. As might have been expected, at the first execution by this method there were certain defects of a minor character in the arrangement and operation of the apparatus which those in charge of the next execution, guided by present experience, will be able to avoid or overcome. But, in spite of these defects, the important fact remains that unconsciousness was instantly effected and death was painless. When this is understood, together with the additional fact that less than four minutes elapsed from the time the first contact of the current was made to the time the last one was discontinued, and Kemmler was absolutely dead, it will be conceded by all fair-minded persons that the object to be attained, as far as relates to the individual, in the execution of a criminal—namely, sudden and painless death—was fully realized in Kemmler's case. And had the first contact of the current been maintained for fully twenty seconds, as first suggested, in all probability there would have been no reflex movement after it was broken, and no unfavorable criticism of the result could then truthfully have been made. The reflex movements referred to were similar to those which have occasionally been observed for a short time in animals experimentally killed by electricity after the current was too quickly interrupted, the animal, however, not recovering consciousness or life. Hence they may properly be regarded as involuntary muscular movements of a reflex character, following the interruption of the current, and in no sense a resumption of normal respiration, however much they may appear to be so to a superficial observer or to one not familiar with the phenomena in animals above referred to." In addition to the report, several amendments of the present law were suggested, as follows. "That there shall be only one place in the State for executions by electricity instead of three, as at present; that a separate building shall be constructed for such executions, with suitable cells for the accommodation of criminals awaiting the death penalty; that the dynamo shall be in immediate communication with the execution room, and not a thousand feet distant, as was the case at Auburn; and that the dynamo employed for executions shall be capable of generating an electrical force of three thousand volts." (Carlos F. MacDonald, M.D., Chairman of the State Commission in Lunacy.)

"The execution of Kemmler was a more decent and dignified execution of the law than any other I have ever seen. That the admission to the chamber of death of persons who had never seen an execution, and knew nothing whatever of the effect of electricity on the human body, led to many extravagant and erroneous statements I really believe. There was no warrant in law for the presence of such persons. . . . In my opinion the man was dead within an infinitesimal part of a second after the current was turned on." (E. C. Spitzka, M.D.) It may be of interest to state that during Dr. Spitzka's examination of the body of Kemmler, a phenomenon

which is generally regarded as a sign of life was apparent. This was noticed after the brain, heart, and other organs had been removed from the body, and consisted of the markings of the flesh by pressure with the finger and the subsequent disappearance of the marks thus effected.

"The value of this method of execution is now beyond doubt. When properly performed it is rapid, painless, and not repulsive. The criminal has probably no physical sensation of pain or discomfort due to the mode of death from the moment the first shock occurs. Since the rapidity of the transmission of the electric current through the body is in these cases much greater than the rapidity of the transmission of sensation, it seems just to conclude that no sensation from the electricity reaches the consciousness. The only distress suffered by the criminal is the unavoidable mental suffering natural to his position." (William N. Bullard, M.D., 1894.)

"The best appliance in this connection is, to my mind, the one which will perform its work in the shortest space of time and inflict the least amount of suffering upon its victim. This, I believe, can be accomplished by the use of electricity, and the most suitable apparatus for the purpose is that class of dynamo machinery which employs the intermittent currents. The most powerful of these are known as 'alternating' machines. The passage of the current from these machines through the human body, even by the slightest contact, produces instantaneous death." (Thomas A. Edison, Esq., 1889.)

"There is some ground for d'Arsouval's theory, and it is surely worth trying in case of accident, but there is no reason for experimenting on criminals who must be killed to carry out the law. If there is any doubt as to their death, the current must be continued until they are dead. Under the recent improvements in electrocution such a thing as resuscitation is hardly possible; yet the theory of resuscitation is founded on correct scientific principles. There is in these electrocutions of criminals a question whether the autopsy shows that death results from the electric shocks, and this theory of forced respiration rests on a rational basis; therefore, there should be experiments, not on criminals, but in the accident cases." (George F. Shrady, M.D., editor of the *Medical Record*, New York.)

"If it is properly done a man can be killed by electricity. But it seems to me that the law has gone out of its way to choose an uncertain method, for it does not of necessity follow that even the strong current received in the electric chair produces death. Often a very severe shock is received and may pass over the surface and not reach the vital organs. There are cases of electrocution where resuscitation is possible. Take the case of William G. Taylor, who was electrocuted at Auburn in July of last year (1893). A current of twelve hundred and sixty voltage was turned on, and his legs shot forward and upward, tearing the entire front from the electric chair. This condition was sustained for fifty-two seconds. For twenty seconds he remained perfectly dead with froth oozing from his mouth. At that time his pulse could not be felt. But thirty seconds later there was a

faint pulse and slight respiration. He was removed to a cot and the respirations went to 12 or 13, and the pulse reached 100. He also moved his legs. At forty-eight minutes after the contact his pulse was 130, full and vigorous. He was again placed in the chair and the second contact made and continued for forty seconds. An examination proved him dead by a voltage of twelve hundred and twenty. This case, and another reported quite recently in France by d'Arsouval, raises the important question of how electricity kills, and whether the production of asphyxia is not what really takes place. It certainly is a grave question whether post-mortem examinations should not always be delayed until the matter of death is indisputably settled. I have from the first been opposed to execution by electricity; it is brutish and cruel. If it is not attended by the greatest care, which will not be the case if electricity is generally used, there will be many deaths not immediate, and several attempts have to be made, as in the cases of Taylor and Kemmler. Carbonic acid gas would be a much better agent, and in its use there would be nothing cruel, horrible, or expensive." (Allan McLane Hamilton, M.D.)

"I believe that d'Arsouval's statements are thoroughly well founded. I believe, further, that the death by electricity is horribly cruel. This opinion is based on the statements of those who have received shocks of electric current of the strength used by the State, and who describe their sensations under the ordeal as 'the tortures of hell.' How long the victim is subjected to this torture before becoming absolutely insensible can, of course, according to our present light, be only a matter of conjecture; but that he actually does suffer excruciatingly for some period of time is a matter about which there can be not the slightest doubt. The characterization of electrocution as a humane method of killing is based on entirely insufficient premises, and is in the highest degree misleading and inaccurate. It is to be hoped that the results of d'Arsouval's investigations will be brought to the attention of the Legislature, and that this mode of capital punishment may at length be regarded in its true light and abolished." (Joseph Wetzler, Esq., editor of the *Electrical Engineer*.)

"I should be in favor of accepting d'Arsouval's statement. I do not believe it to be well founded, but the difficulty is to answer it by any definite physiological experiment as against the reputation of so great a physiologist and physician as d'Arsouval. His experiments and opinion carry very great weight, and the only answer to his statement that appears to me available is a practical one. I would advocate that the law be changed relative to the time that the autopsy should be performed; in other words, that the autopsy should wait for the signs of decomposition, which I am positively certain—*i.e.*, morally certain—would appear. To delay the autopsy seems to me the only positive answer to M. d'Arsouval. All others are speculations and hypotheses, possibly akin in that sense to his own observations. . . . My opinion is still, unquestionably, that the modern method of execution by electricity is the perfected art of killing. I think that by it

death is as nearly instantaneous, and that we know to be as near instantaneity as man can get, and as rapid in action as can be imagined. As quick as is electricity, so quick I believe death by electricity to be, so far as death means immediate and final abolition of consciousness. But it is more than probable that the finality of death in each individual animal cell may be less brief and yet be certain,—*i.e.*, an animal function of the cell is extinguished in an infinitely small portion of a second, never to revive, and still this extinction may not be so rapid as that of consciousness. A parallel to the death of the individual may be found in the experiments of Engelmann upon *l'amœba diffluens*. The amœba is a unicellular organism found in water, a protoplasm that changes its form, travels by its own movement, and bears a decided resemblance to the white blood-cells of the human body. A certain strength of alternating current will cause it to assume a spherical shape, but it resumes its normal movement. A greater degree will cause it to assume a spherical shape, and never again resume movement,—*i.e.*, the function of the cell, which is life, has ceased,—live animal protoplasm has become dead animal protoplasm. That is all, and yet enough. No examination by the most powerful microscope can reveal what has taken place, so simple in the animal cell is the transition from life to death. Why is the argument not equally applicable to each protoplasmic cell of that aggregation of animal cells which constitutes the human body? That, at least, is my view of the cause of death by electricity. I believe it to be the electrical arrest of the functional properties of every living cell,—those of the heart, nerve-centres, nerves, muscles, and all. The only art is to give the shock sufficient strength to make sure of the continuance of this physiological death, and if a doubt remains as to the possibility of this being done, as d'Arsouval maintains with such cogency it does, we must, as human beings, take it into account and delay the autopsy. And in view of the high authority of d'Arsouval, I think the matter is important enough to demand the immediate investigation and action of the Legislature." (W. J. Morton, M.D., ex-President of the American Electro-Therapeutic Association.)

"Pathologically there are no distinctive tissue-changes, nor are there any certain evidences that the subject is dead when taken from the chair. On the contrary, the changes noticeable under the microscope are such only as invariably accompany death in whatsoever manner brought about. Naturally, after dissection the man is dead. But before the scalpel has been employed there are numerous evidences of a most positive character that life is not extinct. One fact alone is evidence sufficient in the mind of any physician,—namely, the redness of the chest, which upon pressure departs but to return again. It matters not how fast or how slow its return may be, if it returns at all the subject is still alive. The return of the color is proof positive of the continued cardiac and arterial contraction. So long as the blood circulates the man is alive, and the returning color is absolute evidence of such circulation. Granting that the man is not dead when so pronounced, then our present capital punishment is the most barbarous one

ever devised in the history of man. As long as a shadow of a doubt remains in the minds of physicians and electricians every opportunity should be most freely and gladly given scientists to settle the question. In this light Warden Sage, by refusing to allow the attending physician to endeavor to resuscitate the victim of an unwise and reckless experiment, would be (in case after-developments prove that the electric chair does not kill) himself personally responsible for the man's death, it not having taken place in conformity to law and the decree of the court. In justice to the humanitarianism of this nineteenth century these questions must be answered some time. Why not now? Why shock civilization again and again with such revolting horror as the execution of John Johnson?" (W. M. Hill, M.D.)

". . . The possibility that the wretched victim could retain any degree of consciousness after passing from the electric chair to the dissecting table, and to any, even the least, degree cognize the progress of the autopsy, is horrifying, if true. Many reputable physicians believe that death is not produced by electrocution, and that the real executioners are those who hold the autopsy; and to sustain those who take this view, electricians of eminence boldly aver that the electrical current does not induce death, and that the New York Commission 'has added the autopsy clause to the law so as to make it certain that the man was dead.' To render this view feasible many well-authenticated instances of simulated death are recited where competent physicians had furnished death certificates and the supposed corpses regained consciousness on the very eve of interment. To add to the awe of the situation comes the well-authenticated fact that men who have been shocked by a higher voltage than that used in our electrocutions have been restored to life after every indication of death, such as our victims present, was fully manifest. Now, lest this outlined condition should lack in any feature of a revolting character, it need only be added that a physician in good standing, practising in this State, emphatically declares that he 'partially resuscitated murderer John Johnson after his electrocution at Auburn, when he was peremptorily ordered by the warden to desist.' He further declares that 'neither Johnson nor Taylor, both of whom were electrocuted at Auburn, was killed by the electric current, but that death was caused by the autopsy.' These facts certainly indicate that this subject ought not to be brushed lightly aside by the mere expression of contrary opinions. Conflict of this kind—which would be largely speculative on assumptions—could only be disposed of by direct experimentation on one who has been electrocuted as prescribed by law. . . . A little more than a year ago I was present at an electrocution in Sing Sing, and assisted at the autopsy. The strength of the current for the first shock was seventeen hundred volts and five ampères, that for the second shock twelve hundred volts, and later a continuous shock of one hundred and fifty volts. I believed then, and do now, that death in that case was instantaneous. The seventeen hundred volts multiplied by five ampères would give eight thousand watts. Now, as seven hundred and forty-five watts is the equivalent of one horse-power,

the first shock this man experienced equalled more than eleven horse-power divulsion in every direction; and remembering the sudden, loud, straining sound emitted by the leather straps and the wood-work of the chair, it is easy for me to appreciate the very great force that must have expended itself in that instance, and implanted in my mind the accepted fact that death was almost instantaneous and painless from its very suddenness and the victim's feeble physical resisting capacity. . . . In the case I witnessed the alternating current was used, and the autopsy failed to reveal any microscopic appearances that could be attributed to the electric current's capacity to induce destructive tissue-changes. . . . In view of the many perplexing problems embodied in this subject, where speculation is so free as to results of a given manifestation of the presence of a force of whose entity we know practically nothing, and when we consider the benefit any material fact must necessarily be relative to so potent an agent now in general use, whether that fact adds to its present usefulness or diminishes the risks daily incurred by those who are employed in harnessing this new and little-understood adjunct to our civilization, I see but one way to take the present discussion from the realm of horrors in which it now abides and place it on a firm basis of true knowledge, and that is by intelligent experimentation." (William J. O'Sullivan, M.D.).

In the Sing Sing, Auburn, Clinton, and Dannemora prisons apparatus are placed for the electrocution of murderers. These are in the main practically the same at each prison. The death-chamber is a room of reasonably fair dimensions, capable of holding those, besides the condemned man and the officers, who are entitled by law to be present as witnesses. Chairs are provided for their convenience, and are so placed about the execution chair as not to in any way interfere with the management of the apparatus. Considerable space is therefore allowed for this purpose. An alternating current dynamo and its necessary adjuncts constitute the electric plant. These are connected by wires with the switch-board in the death-chamber. The latter place also contains such accessories as a voltmeter, ammeter, etc., for noting accurate measurements in connection with the current. Both the plant and the switch-board are in charge of an expert electrician, while on the engineer devolves the duty of attending to the dynamo. Communication is established between the two by means of electric bells, etc.

The execution, electric, or death-chair is secured to the floor of the apartment and insulated. It is made of beams of oak, and provided with broad arms and an upright back. The latter can be inclined backward to almost any desired position and securely fastened. A head-rest is attached to the upper portion of the back of the chair; it can be raised or lowered as desired. When a criminal is placed in the death-chair a moist electrode is usually placed at the head, so as to cover the forehead and temples. Other electrodes are fastened at the ankles by means of straps. They are moistened with a solution of water and salt, a drip being permitted to play over the parts for more thorough work. "In the case of Kemmler they (the elec-

trodes) each consisted of a bell-shaped rubber cap about four inches in diameter, with a wooden handle through which passed the wires into the bell to end in a metallic disk about three inches in diameter, faced with sponge. The upper electrode was so arranged as to rest firmly on the top of the head, where it was held closely by means of a spiral spring ; it was attached to the horizontal arm of the head-rest, a sliding arrangement shaped like a figure 4. The lower electrode was in this case attached to the lower part of the back of the chair, and projected forward at a level with the hollow of the sacrum. There was also connected with it a sliding arrangement and a spiral spring which, in connection with a broad strap around the prisoner's lower abdomen, rendered it secure." (Bullard.)

As has already been pointed out, a certain amount of resistance is offered by the body to the passage of the electric current through it. When a person is secured in the death-chair for electrocution purposes and the current turned on, says Burton, "the body of the victim offering resistance to the path of the electricity between the poles becomes filled with the fluid sufficient to overcome the resistance of the body, if the current is of proper force and volume. When the resistance has been overcome, the victim being in no way brought in contact with the earth, the current has no means of escaping, and the body will not receive any more of the fluid. In different persons there is such a varied resistance of the human body that it is impossible to state where to draw the line between the amount of current that will produce death and that which burns the victim to death. It is plain that currents of electricity, as used in killing murderers in the State of New York, are injected into the body in a totally different way from the current received by a lineman, or by a person coming in contact with a broken wire lying upon the ground or in circuit with other conductors of electricity. A lineman generally receives severe burns about the hands and arms, which cook the flesh, and then follows the roasting of the victim, proving that the man is more burned to death than killed from the shock. A person coming in contact with an electric wire which has connection with the ground establishes an excellent conductor for the current, by means of which it passes to the ground. The earth being a better conductor than an animate body, the current simply passes through that body when placed in circuit between the dynamo and the earth, and in this way it is possible to continue the current through the victim, which is not the case when a man is placed in the electrical chair. In the latter instance the current simply passes from one pole of contact to the other, without chance of escape ; and until the body offers no further resistance, and unless the current is of sufficient intensity to roast the victim, death will not occur. . . . If a body is left in the alternating circuit of a machine generating from seventeen hundred to two thousand two hundred volts, and the current is suddenly varied between high and low pressure, and continued sufficiently long, and if the resistance of the body of the victim is very high, notwithstanding the continued interruptions of the current by making and breaking the circuit, the sudden attack upon the

action of the heart by the fluctuation of the current between high and low pressure alone would be sufficient to cause death. But such use of electricity is not in conformity with the law of the State, which plainly says that the murderer is to receive a 'current of electricity of sufficient intensity to cause death, and the application of such current must continue until such convict is dead.' Are we to interpret the law to mean that when the current is turned on at, say, seventeen hundred volts, the electrocutioner has the right to vary the voltage, or make and break the circuit, producing a variable and interrupted current? The moment the voltage is changed, by mechanical or other means, it becomes a new and varied current. I still adhere to my original statement, that the condemned men in New York State are simply filled with electricity until the resistance of the body is overcome, and that unless frequent shocks of the current, ranging between very high and low pressure, are given the victim, or the circuit is made and broken several times, it is impossible in many cases to cause death, provided the treatment heretofore used be followed. I am thoroughly convinced that many of the men who have been pronounced electrocuted in New York State have been placed upon the dissecting table conscious of what was going on and what was about to take place. I find in the testimony given by Francis W. Jones in the case of the people of the State of New York *ex rel.* William Kemmler, appellant, against Charles F. Durston, warden of Auburn Prison, that he found, after measuring, the resistance of the body of said persons varied from thirteen hundred to forty thousand ohms, and that the resistance of his own body, under test, was eighty thousand ohms. I also find expert testimony in said case to the effect that a current of sufficient volume could be given a person to thoroughly carbonize the body. . . . It must be admitted that since the introduction of the electric chair wonderful changes have taken place concerning the art of electricity. The alternating current, which it was proposed to prove was so deadly, has taken the front rank in matters electric, but it has never been proved that it was more injurious in its effects than the continuous current. The evidence at this writing tends to show the opposite. As a matter of record, men have been restored to consciousness and life after having received a very much higher voltage under the alternating system than ever was known to have been received from the continuous current."

So conflicting are the opinions of scientific men regarding the applicability of electricity as a mode of executing criminals, and so bungling have been some of the executions, that efforts have been made toward the repeal of the law in the State of New York.

The following list, furnished the writer through the kindness of Warden Sage, of Sing Sing Prison, is complete up to the time of its receipt. It gives the names of those electrocuted at that prison, the date of sentence, etc. The number of electric contacts varied from one to four. For the last seven or eight cases mentioned in the list only one contact was necessary. The average time was about one minute.

Date of Execution.	Name.	Date of Sentence.	Received in Prison.	County.
July 7, 1891.	Schihiack Jugigo.[1]	Dec. 16, 1889.	Dec. 17, 1889.	New York.
July 7, 1891.	James J. Slocum.[2]	Mar. 21, 1890.	Mar. 26, 1890.	New York.
July 7, 1891.	Joseph Woods (B).	April 1, 1890.	April 8, 1890.	New York.
July 7, 1891.	Harris H. Smiler.[3]	Jan. 26, 1891.	Jan. 26, 1891.	New York.
Dec. 7, 1891.	Martin D. Loppy.[4]	Oct. 23, 1891.	Oct. 23, 1891.	New York.
Feb. 8, 1892.	Charles McElvaney.[5]	Oct. 23, 1889.	Oct. 31, 1889.	Kings.
Mar. 28, 1892.	Jeremiah Cotto.	Dec. 4, 1891.	Dec. 5, 1891.	Kings.
Dec. 19, 1892.	Frederick McGuire.	April 22, 1892.	April 22, 1892.	Orange.
Apr. 3, 1893.	James L. Hamilton (B).	July 14, 1892.	July 18, 1892.	Queens.
May 8, 1893.	Carlyle W. Harris.	Mar. 20, 1893.	Mar. 23, 1893.	New York.
June 12, 1893.	John Osmond.	April 20, 1892.	July 20, 1892.	New York.
Dec. 4, 1893.	John Delfine.	April 25, 1893.	April 26, 1893.	Kings.
Feb. 26, 1894.	Matthew Johnson (B).	April 24, 1893.	April 24, 1893.	New York.
Jan. 28, 1895.	David Hampton (B).	May 11, 1894.	May 11, 1894.	New York.
July 1, 1895.	Robert W. Buchanan.	Aug. 14, 1893.	Aug. 15, 1893.	New York.
Aug. 5, 1895.	Richard Leach.	Jan. 22, 1895.	Jan. 23, 1895.	New York.

Other murderers who were electrocuted at various times in the State of New York were Hood, Tice, Kemmler, and "Bat" Shea. Kemmler, who was the first person shocked to death by electricity, was subjected to two contacts of the current, the first one lasting for a period of seventeen seconds, and the last one for seventy seconds. Hood experienced three contacts, each of which lasted for twenty seconds, and the total time that was consumed in executing Tice was fifty seconds.

The murderer Shea, the last to be put to death (at this writing), was electrocuted February 11, 1896, at Dannemora prison. The current was continued for one minute and twenty-one seconds, and the voltage was eighteen hundred. When the current was closed the victim was officially pronounced dead.

LIGHTNING.

Effects of the Current of Electricity—Cause of Death—Symptoms—Injuries due to Lightning—Post-Mortem Appearances—Medico-Legal Relations of Death from Lightning.

Lightning is occasioned by a discharge of atmospheric electricity between the clouds or between a cloud and the earth. It is exhibited in various forms, such as heat (sheet) lightning, etc. The ancients knew little or nothing of the nature of this electric discharge. The dangerous effects of this fluid were associated with the thunder rather than with the flash, and

[1] Jugigo; number of contacts three, each lasting twenty seconds.

[2] Slocum; number of contacts two, each lasting twenty-seven and twenty-six seconds respectively.

[3] Smiler; number of contacts four, each lasting twenty seconds except the last, which was nineteen seconds.

[4] Loppy; number of contacts four, each lasting fifteen, eleven, fifteen and one-half, and ten and one-half seconds respectively.

[5] McElvaney; number of contacts two, each lasting fifty and thirty-six seconds respectively.

the earliest electricians did not even suspect the identity of lightning and electricity.

Besides heat-lightning, there is another form which appears in zigzag lines across the clouds. It frequently strikes toward the earth, and occasionally from the latter to the sky. The direction of its motion is well defined, notwithstanding the fact that it is not visible for the millionth part of a second. (Arago.) Upon the surface of the earth lightning follows the course of the best conductors, or it occasionally changes its direction and chooses the line of least resistance. Its course is always a direct rather than a tortuous one. During a storm the polarity of the cloud is almost always positive, while the electric condition of the earth is negative. Intensification of these polarities by mutual induction produces the electric discharge through the atmospheric air, or any other body interposed in its path. Bad conductors, therefore, are violently shattered or disorganized, and human beings and animals immediately killed. The flash is always accompanied by loud reports of thunder, although heat-lightning is usually unaccompanied by this sound.

During the period of five years (1890–1895) lightning was the cause of the death of eleven hundred and twenty-five persons in this country. The greatest number of fatalities occurred in the months of July and August, although many deaths by lightning were recorded during June; but, with few exceptions, these fatalities took place between the months of April and September. Therefore the most frequent time for death from lightning to occur is during thunder-storms in the summer time and in tropical climates. The hot summer months are the favorite times for the activity of lightning. In some States thunder-storms wreak more vengeance than in others, and lightning seems to possess a partial affinity for certain kinds of structures: thus it is that barns and stables seem to be more favored (?) than buildings of any other kind. Churches, however, are included as favorite points for the play of the lightning, no doubt on account of the attractive steeples which seem to invite the acquaintance of the electric fluid. The United States government has issued a pamphlet on this subject, and from it we learn some curious facts. During 1892 the damages from fires produced by lightning reached the sum of three million dollars, and in no one year since a record has been kept has the loss been less than one million dollars. During ten years one hundred and twenty-nine churches have been struck by lightning.

The Bureau of Statistics at Berlin recently gathered some statistics which go to show that accidents from lightning-strokes have greatly increased of late. This is said to be due to the disappearance of forests, to the employment of electricity in various industries, and to the carbon vapors arising from towns and cities. The number of such accidents in France is also very much greater than at the commencement of the present century. As a rule, men suffer death from lightning-stroke more frequently than do women or children, on account of the nature of their occupations, which are mostly

out of doors. Persons who are in open fields or those under trees during an electric storm are much more liable to be struck by lightning than those remaining at their homes within doors.

Many curious pranks of lightning are recorded. The following case occurred at Glen Cove, Long Island, New York. Two boys were sitting on a stoop watching the progress of a thunder-storm, when all at once the current made a sudden bolt toward them. It shattered a section of the house into splinters, and played about the boys in a blue flame. It leaped over them and bristled their hair and entered the earth. The young persons were stunned, and discovered lying upon their backs perfectly unconscious. On being undressed a photograph of an old tree which stands near the house was seen upon the leg of each boy. The picture is said to be a very fair representation of the tree, and has been viewed by many persons. Effacement of the so-called photographs was found impossible, so thoroughly imprinted were the marks done by the electric current. The boys ultimately recovered and are doing well. It appears to the writer that such resemblances on the body are fancied rather than real, being occasioned by some process which brings to plainer view the superficial veins of the parts struck.

Death from the effects of lightning-stroke is either instantaneous or the victim may die subsequent to the inauguration of the secondary effects. In most cases, however, if fatal results are not immediate there may be great hopes of ultimate recovery.

"The capricious action of the discharge is shown by the fact that out of a party of three or four sitting under a tree, one or two only may be killed and the others escape. Again, it has occurred that persons under a low tree have been struck, although high trees and a lightning-rod and an iron bridge were near. Again, the same discharge may produce on one person wounds and burns in another. The diversity of its action on the clothes may probably be explained by the circumstance of a portion of the clothing being wet and a portion dry; the former, being a good conductor, might escape the disruption which would be exhibited by the dry portion, which is a bad conductor." (Reese.)

Cause of Death.—Lightning appears to act fatally by producing excessive shock to the cerebro-spinal system. Occasionally it causes lesions of the spinal cord and brain, which may subsequently end in death. After a person has been struck by lightning he hardly experiences any sensation of pain, as he immediately passes into a condition of unconsciousness. In cases where the lightning-stroke has acted fatally, the visible effects produced are thus described by Reese.[1] "Sometimes a deep punctured or lacerated wound will indicate where the fatal blow was struck upon the head, neck, or other part of the body; the hair may be singed or burnt off; the clothing may be burned or completely stripped off; the boot may be

[1] Op. cit.

split open. Again, the course of the electric current may be marked by a deep or superficial burn, extending from the point of entrance down and around the body to the ground. If there should happen to be any metallic substances in contact with the body, such as chains, coins, a watch, etc., as these are good conductors of the electric current, it will be certain to include them in the circuit, and they will be frequently found to have been melted. In other cases of death by lightning, no external wound or burn may be visible. Sometimes there may be severe external injuries, while the clothes entirely escape. Again, the clothing may be completely torn off the body, while the latter exhibits no injury whatever."

Symptoms.—These are subject to variation according to the severity of the shock. In the milder cases the patient experiences a sensation of numbness, and at the same time appears dazed. The force of the stroke of lightning has been likened to a blow, accompanied by flashes of light which momentarily blind the sight. The face is usually flushed and reddened and the pupils dilated. The symptoms of collapse soon follow, the sufferer becomes cyanosed, and signs similar to asphyxiation ensue. Occasionally there is fever. The pulse may be rapid or slow or scarcely perceptible. In other cases it is irregular and extremely feeble. Breathing is commonly labored, and dyspnœa may be marked. Nausea and vomiting may follow the return of consciousness.

Of the nervous symptoms shown in the severer cases of lightning-stroke, loss of sensibility, loss of memory, paralysis, convulsions, and disturbances of sensation and of the special senses are the most frequent. Loss of consciousness is experienced in almost all cases of lightning-shock, with the exception of the milder ones. Even here the subject experiences partial insensibility. Loss of memory is not rare, although in some cases it will be found wanting. Of the mental diseases observed, mania and the delirium of terror have been observed in some cases. Recovery is often found to be associated with such conditions as epilepsy, paralysis, anæsthesia, hyperæsthesia, partial or total blindness, and total loss of memory. Hemiplegia is not rare, and almost any of the forms of paralysis of the extremities may occur. Ptosis, facial paralysis, difficulty in mastication, retention of urine, dysuria, aphasia, and the loss of co-ordination in the lower limbs, together with partial paralysis of the bladder and rectum, have been noticed in some cases. Pain is usually experienced, but it most frequently occurs as a secondary result of injuries or burns. It may occur, however, as a direct result of injury to the part affected by the lightning. Headache and disturbances of sensation other than pain are not infrequent symptoms in these cases. Anæsthesia may occur with or without paralysis, while in other instances hyperæsthesia may be very well marked. It is usually of temporary duration, lasting only a few hours. Paræsthesiæ are most frequent as results of lightning-stroke. The deep reflexes are generally found to be normal, the more superficial ones being but temporarily increased.

As regards the sight, it may be entirely lost, as stated above, or it

ay suffer secondarily as a result of injury, such as burns, to the eyeball self. Loss of sight is usually of but temporary existence. Other signs in onnection with the eyes are amblyopia, photophobia, lachrymation, and ain; and in some instances cataract and other severe affections of the rgan may follow. The hearing is sometimes so affected that the sufferer xperiences the greatest difficulty in appreciating sounds. In other cases eafness is pronounced. Dulness of the senses of taste and smell may exist.

Partial or permanent staining of the epidermis may result where metallic substances were carried at the time of the lightning-stroke. Loss of hair has been noted in a few instances; and in one case, referred to by Bullard, "all the hair of the body is said to have fallen out." Seminal losses at the time of the stroke are not unusual, and the flow of blood during menstruation has been checked.

Injuries due to Lightning.—These are remarkably varied. Sometimes the location of the part struck by lightning will be indicated by the injury. In other cases, however, death may ensue without any visible effects of the current. (*Vide ante.*) Wounds may be direct or indirect, and, like electric burns, are usually to be found at those parts of the body offering the greatest resistance to the current. Fractures are of rare occurrence, although they may take place. Tidy refers to a case where the os calcis, tibia, and fibula were fractured. When they do occur, they are usually found at the part struck. Burns and blisters are most common in lightning cases, but they may be occasioned by the clothes of the victim taking fire. (*Vide* Cause of Death.)

Post-Mortem Appearances.—Rigor mortis, according to Tidy, does occur, although some authorities differ. Bullard[1] says, "As regards its occurrence in death by lightning and the rapidity of its onset there has been much discussion. It is certainly present in many cases, and the probability is there is nothing diagnostic in regard to it in deaths by lightning." Its rapidity of occurrence is not increased by this mode of death. Coagulation of the blood occurs, but its inauguration is somewhat retarded. The face is frequently found to be bloated and discolored. Generally speaking, the spot at which the electric current gained entrance is surrounded by more or less marks of contusion and laceration. Penetrating wounds are often noticed in this connection; also burns, vesications, and ecchymoses. Fractures are sometimes found, especially those of the cranial bones.

There may be congestion of the brain, and extravasations of blood under he skull and into the ventricles. Complete disorganization of the organ tself may be apparent in some cases. The lungs may be hyperæmic and njured. The air-tubes are in many instances plugged with mucus. Conestion usually exists in the other internal organs, such as the stomach, instines, liver, etc. The heart may be either full of blood or entirely empty,

[1] Op. cit.

no other special alterations being noticeable, as a rule. The blood is generally dark and fluid.

The morbid anatomy in a case of death by lightning-stroke is thus described by Dürck.[1] "The skin was abraded on the left side of the forehead, the point at which the electric current gained access. Extensive effusions of blood over the left parietal, frontal, and temporal lobes were apparent, and fluid blood was found in the heart and veins. All of the abdominal organs were in a state of congestion, and there was a chronic enlargement of the spleen, probably of malarial origin. The cerebral substance was very soft, but without œdema." These were the summary of his observations: (1) the blood is deficient in coagulating power, which latter may even be entirely lost; (2) circumscribed or extensive hemorrhages, occasioned by the tearing of blood-vessels in the course of the current, are usually present; (3) there is often destruction of parts of organs; and (4) the location of the entrance and exit of the electricity is usually marked by superficial or even deep wounds resembling burns. As regards the figures on the surface of the body of the subject, Dürck says that more extensive investigation is required in order to establish their direct relation to the current of electricity.

Medico-Legal Relations of Death from Lightning.—The medico-legal interest in these cases is not of very great importance. The question of identification, or that of being able to distinguish injuries occasioned by lightning from homicidal cases due to violence, may arise. Again, the injurious effects of lightning accidents may assume importance in insurance cases. With these exceptions, such cases have not great forensic interest, although the attention of the medical expert may be claimed in those instances where it becomes necessary to determine the cause of death in an unknown case, when the subject has been discovered in a place by no means exposed, etc., or in a locality remote and solitary. The finding of external injuries on the body, which may simulate those due to violence, renders his assistance still more urgent.

[1] Münchener Medicinische Wochenschrift, July 30, 1895.

CHAPTER XXXII.

DEATH BY HEAT AND COLD.

Animal Heat and the Extremes of Temperature—Effects of Extreme Heat on the Body—Sunstroke, etc.—Post-Mortem Appearances—*Effects of Cold*—Symptoms—Treatment—Post-Mortem Signs—*Death by Starvation.*

By animal heat is meant the temperature at which the body of a warm-blooded animal is maintained. The healthy or normal temperature of man is 37° C. (98.6° F.), but in some individuals it is liable to vary a fraction of a degree. Furthermore, the temperature taken in the axilla may fall to about 36.1° C. (97° F.) without causing collapse, or it may rise to 37.77° C. (100° F.) without any manifestations of fever. These extremes of temperature are seldom exceeded, even in children. The bodily temperature is influenced by certain conditions, such as age, sex, period of the day, exercise, climate, season, and food and drink. In new-born children the temperature is one degree above that proper to grown persons, and in mature or adult life the body heat is lower than at any other period until its rise again in old age. The *period of day* influences animal heat in the variation, which may be equal to one or one and a half degrees. The minimum heat is found to exist late at night or very early in the morning, while the maximum is found late in the afternoon. *Exercise* causes the temperature to rise. As regards the actual amount of increase there has been much discussion among physiologists. Some state that it seldom or never rises more than one degree, while others, equally eminent, assert that exercise raises it much more. The great rise of bodily heat observed in tetanus, where there is great muscular contractility, is thought by some writers to be the result of some pathologic condition. The influence of climate and season is very slight. Another point of importance in this connection is that there is a difference in the temperature when taken at different parts of the body. Thus, the palms and soles of the hands and feet are cooler than any other portion, while the liver frequently reaches 40° C. (104° F.) or more.

The variations in temperature in *disease* are considerable. In certain fevers and neuroses it may rise as high as 41.1° C. (106° F.) and 43.3° C. (110° F.), or even 45.6° C. (114° F.), as has been observed in some cases of scarlet fever; while, again, it may take an opposite course, and sometimes fall to 26.7° C. (80° F.) or 25.6° C. (78° F.), as in cholera. In some cases of alcoholism, especially where the subject has been exposed to a cold and damp atmosphere, these low temperatures are encountered. Thus, Magnall reports an instance of an intoxicated person, who was exposed to the elements, whose temperature registered 26° C. (78.8° F.). Certain diseases furnish an increased bodily heat just previous to dissolution; while, on the other

hand, others exhibit a very low temperature just before death. These great extremes are, however, exceptional. Death is certain in those cases where the bodily temperature is raised, by any means, 6.1° to 7.2° C. (11° to 13° F.) above that which is healthy or normal, and maintained for any length of time.[1] Young people are said to bear the effects of intense heat better than adults or those of great age, but there are exceptions.

The two functions that govern the heat of the body are heat-production and heat-dissipation, and the effect of an increase of the former and a decrease of the latter is an increase of the temperature,—in other words, fever. Again, when the heat-production is decreased or the heat-dissipation increased there is a decline of the bodily heat. These two functions are so evenly balanced that disorder of either of them causes either an increase or a decrease of temperature. Cold surroundings, contact of the body with substances which easily conduct the heat away, or conditions which attract large amounts of heat to the body surface increase the dissipation of heat. The temperature of the animal organism is kept uniform by the circulation of the blood.

The temperature of the body is lowered by *starvation*. *Hemorrhage* at first produces a slight fall of temperature, but afterwards there is an increase of several tenths of a degree. The temperature may again fall during the course of a few days. Another important point to bear in mind is, that in those individuals who are occupied at night, instead of during the daytime, during which they sleep, the course of the temperature is inverted from that which has been previously stated as normal. The main cause of the decline of temperature after hemorrhage is the interference with proper oxidation.

Effects of Extreme Heat on the Body.—If moderate heat be applied to the surface of the body, dilatation of the capillary vessels ensues, while the functions of the skin are increased, the perspiration by its evaporation aiding in the dissipation of a too rapidly increasing temperature. Stoddard[2] says that if "severe physical exertion accompany the exposure, a more pronounced result is induced, and a depressing effect upon the nervous system becomes manifest. If the degree of heat be raised and the exertion increased and prolonged, marked depression ensues. Under circumstances of quiet and rest a high degree of temperature is borne by man without depression or discomfort; but with continued and severe muscular effort the rise in animal temperature is productive of distress and depressing conditions."

The cause of so much distress among children during the summer months is the rise of temperature. The depressing effects of great heat

[1] Morrant Baker states that Chabert, the "fire-king," stood in a temperature ranging from 400° to 500° F., while it is known that workmen in iron-furnaces sometimes stand upon a furnace floor which is red hot, and the air of which registers 350° F. Blagden survived a temperature of 260° F. for eight minutes, having trained his epidermis to great and active secretion, a function which enormously dissipates heat.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

are also ill borne by those advanced in life or the enfeebled. The high atmospheric humidity prevents the proper evaporation from the body, thereby increasing its temperature. According to Wood,[1] there are three conditions produced by great heat,—*i.e.*, (1) acute meningitis or phrenitis, (2) heat-exhaustion with collapse and syncopic tendency, and (3) thermic fever due to artificial heat.

Sunstroke ("*insolation;*" "*coup de soleil*").—This affection is produced by exposure to great solar heat, over-exertion, and an insufficient supply of water. The term is also applicable to those cases occurring as a result of exposure to other sources of extreme heat. The usual phenomena are exhaustion, unconsciousness, difficult or stertorous breathing, and death, following syncope, within a comparatively short space of time. In other instances the signs of cerebral hemorrhage with death by coma are observed; or, in still others (the majority of the cases), a combination of these symptoms exists with death by syncope.

The ordinary symptoms of the attack are preceded by the prodromata, such as great heat and dryness of the skin,—a constant symptom,—a sense of exhaustion, thirst and nausea, vertigo, præcordial oppression, frequent micturition, incontinence of urine, restlessness, sleeplessness, occasionally delirium, and headache, which is not a constant symptom. The actual signs are tinnitus aurium, dimness of vision, and the sufferer falls partially or completely unconscious. In some instances a tremor or general convulsion passes over the entire body. The face is pale, and the pupils either dilated or contracted and unaffected by light. The patient's pulse is rapid, compressible, and small, and occasionally of an intermittent character. His respirations are short, shallow, and interrupted by deep-drawn sighs, and he may attempt spasmodic movements at his chest, as if to remove something of an oppressing nature. The convulsions spoken of may be so severe as to stretch him out stiff and rigid for some seconds, and then gradually relax, with somewhat hesitating twitches, which usually mean a repetition. In some cases the face and surface are flushed or cyanosed, the conjunctivæ injected, and the breathing difficult and stertorous. Again, the pulse may be bounding and the skin excessively dry and intensely hot (40° to 43.3° C.). A man in this condition will usually not survive long, though he may recover consciousness in a short time under proper treatment.

The *sequelæ* of sunstroke are headache, which is usually persistent, insanity, temporary hemiplegia, and transitory delirium. In those who are feeble or very old, and in whom the chances of recovery are slim, death is usually speedy.

The *differential diagnosis* is from alcoholism, opium narcosis, cerebral hemorrhage, embolism, etc. The *treatment* should be instituted at once, for the sooner such a patient is treated and recovers from his unconscious state the less danger will there be of cerebral injury. The patient

[1] Medical Times, Philadelphia, 1876.

should be carried to a shady location and his outer clothing removed. If the power of deglutition is not lost, he may be allowed water, but not ice water. If, however, he be insensible, the surface of the body should be mopped with wet cloths, which has a tendency to relieve the abnormal condition of the circulation, so that in a short time the power of swallowing may return. If, on the other hand, the patient passes into a comatose state, he must be treated as if it were a case of apoplexy. *Heat-exhaustion*, with feeble heart and pulse, is best treated by the administration of stimulants and sponging with spirit and water if the skin is hot and dry. Rest is essential.

The *post-mortem appearances* of sunstroke (insolation) are not always characteristic. Local congestions are commonly observed. Decomposition occurs soon after death, and rigor mortis is marked. Delafield and Prudden[1] state that "in autopsies which were made within two hours after death the increased heat of the skin was still maintained." The brain is congested in some cases, while in others there is no apparent change from the normal. Occasionally there is an increase of the serum under the pia mater, together with thin and small effusions of blood. These latter may also exist between the pia and the dura mater. Congestion of the lungs and kidneys is sometimes present; but in the other viscera there are no especial lesions with the exception of those due to the condition of coma existing before dissolution. The consistence and color of the heart may be changed, while the left ventricle may be contracted and the aorta found empty. Wood[2] says that the blood is dark and fluid. The liver and spleen are usually dry and congested.

The attention of the legal physician is sometimes called to these cases on account of their occurrence at some place remote from witnesses.

Effects of Cold.—Death may result from continued exposure of the human body to a low temperature. Instances of the employment of this mode of death with homicidal intent are recorded. It has been ascertained by experimentation that if a warm-blooded animal is kept in an atmosphere so intensely cold that its normal bodily heat is reduced for any length of time 10° to 15° C. (18° to 27° F.), death is certain. Of course there are persons whose abilities to endure great extremes of cold are remarkable. Take, for example, the Arctic explorers. Of these Stoddard[3] says, "The experience of Arctic explorers in the expeditions of Kane, Nares, Greely, and others has demonstrated the power of endurance, for a considerable period, of a temperature from 90° to 100° F. below the freezing point."

Among the predisposing factors to the effects of severe cold are age, exhaustion, such as fatigue, loss of rest, insufficient nourishment, intoxication, mental depression, and former illness. The attention of the medical examiner may be demanded in cases of death in young children, the insane, and the injured.

Infanticide is frequently committed by the exposure of a new-born to the

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[1] Path. Anat. and Hist., 1892. [2] Op. cit. [3] Op. cit.

influences of an extremely cold atmosphere. Under such circumstances death speedily ensues, since the child's power of resistance is extremely limited. In such cases the importance of carefully examining the body and noting the accompanying circumstances cannot be too forcibly impressed upon the mind of the medical examiner. (*Vide* Infanticide.)

Other cases are on record where young children have been murdered by exposure to cold. Homicides of this character are generally perpetrated for the express purpose of avoiding troublesome care. Old and enfeebled individuals are often frozen to death from culpably careless exposure, and, according to Stoddard, the "criminal neglect to provide medical attendance, food, and other essentials has been proved in some cases of the so-called 'faith cure' or 'prayer cure.'"

Special examination on the part of the legal physician is sometimes called for in cases where insane subjects are unnecessarily exposed to the influences of extreme cold. Thus it often happens in the treatment of these persons, especially those who are intractable, that they are subjected to the cold shower-bath, and instances are recorded where such improper treatment has been the means of producing fatal effects. This method of treating excitable insane persons is not so much in vogue at the present time as formerly. Taylor mentions the case of a lunatic of sixty-five years of age who was compelled to undergo this mode of subjugation, the cold shower being at a temperature of 7.8° C. (46° F.). The sufferer, after taking a dose of tartar emetic, died within fifteen minutes. The authors of such barbarous and inhuman treatment would be justly liable to indictment on a charge of manslaughter. Other cases which demand investigation are those in which the injured or wounded are unnecessarily allowed to bear the effects of exposure to cold. Tidy[1] says that "undoubtedly a wound from which a person would rapidly recover if the injury were properly cared for, might, under circumstances of long-continued exposure, assume serious importance, and even endanger life by inducing complications, such as tetanus. An important forensic question of this nature is possible, seeing how a comparatively slight wound, administered without murderous intent, might in this manner prove fatal."

Death sometimes follows the ingestion of cold water when a person is overheated. Tidy says that these cases do not "strictly belong to the effects of cold, but are more akin to heat-apoplexy," while others regard the causative factor as syncope or asthenia occasioned by the shock; others still consider it to be due to the formation of thrombi in the capillaries of various organs, producing death by apnœa or coma.

A damp cold, such as wet clothing, is more dangerous and depressing than a dry cold. Healthy young adults are not so susceptible to the effects of extreme cold as persons very young or very old, while young males bear cold much better than young females of the same age.

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[1] Op. cit., vol. ii. p. 68.

Symptoms.—The immediate effects of cold upon the body are depressing but if the system be in a healthy condition and the exposure be of short duration, reaction and stimulation ensue. The action of the heart is depressed while the first results are certain painful feelings and a lividity of the skin o a purplish color. Blisters often form on the epidermic surface of the body Headache and vomiting frequently succeed these signs, while in some cases numbness and anæsthesia of the parts are experienced, together with a bloodless and white condition of the skin. As sensation diminishes stiffness of the limbs ensues, owing to the failing muscular contractility. With these phenomena a condition of coma supervenes from which the patient can be aroused only with the greatest difficulty. This condition of coma results from congestion of the nervous centres. Lastly, the functions of respiration and circulation are suspended, and the patient dies *coup de froid.*

Other effects of cold are *chilblains* and sores on the limbs; they are slow in healing, as a rule. In *frost-bite* the part is primarily livid, numb, and cold; but subsequently becomes almost bloodless, ashy gray in color, insensible, and somewhat reduced in bulk. (*Vide* Surgical Works.)

Congestion of the genitals and priapism may follow exposure to cold.

In Lieutenant Payer's account of the experiences of an intense Arctic cold he says, "The men were unable to touch a metal cup with their lips or hands, because it felt like red-hot iron. The cold seemed to paralyze the will, so that the men, from the unsteadiness of their gait, stammering talk, and slowness of mental operations, seemed as if intoxicated,—effects no doubt due to congestion of the brain. Further, the cold created a tormenting thirst. If, to relieve this, snow was put into the mouth, it speedily caused inflammation of the throat, palate, and tongue. If locomotion was stopped, owing to the sleepiness induced, the soles of the feet rapidly became insensible. The secretion of the eyes and nose was greatly increased, while perspiration almost entirely ceased."[1]

Treatment.—To restore warmth is the first principle of treatment. The part affected should be rubbed at first with ice or snow, and subsequently with cold water. The sufferer should next be placed in a cool room, at a considerable distance from any source of heat. When a certain degree of warmth has been restored to the frozen part, the application of wool, cotton, etc., is called for. These substances are non-conductors. Frictions of the surface are indicated when the entire body is chilled. The patient is then put to bed and stimulating lotions applied; hot coffee or alcoholic stimulants may then be administered. Finally, the patient must be carefully guarded from exposure to further cold; hence the covering of his body with woolle blankets is desirable and necessary.

Post-Mortem Appearances.—These are not very characteristic. Th medical examiner should therefore be extremely careful in deciding wheth death was the result of exposure to cold or to some other cause. Rig

[1] Tidy's Legal Medicine, vol. ii.

mortis is rather slow in making its appearance, and lasts a long time. Stoddard says, "In the examination of a body in a case of apparent death from cold, the limbs and internal organs may be found frozen. It must be remembered that this occurs after, not before, death, and the frozen condition must not be mistaken for 'rigor mortis.'" Ogston[1] says that in the absence of any other cause of death, the following signs or appearances of the body and organs therein are conclusive evidence that dissolution was the result of exposure to extreme cold, although in children the appearances are not so well marked as in grown persons. (1) An arterial hue of the blood, except when viewed in bulk within the cavities of the heart; exceptions are, however, sometimes observed. (2) An accumulation of blood on both sides of the heart; this accumulation is unusual. (3) Pallor or paleness of the entire surface of the body of the subject; congestion of the abdominal viscera which are the recipients of the largest blood-supply. (4) Diffused and irregular dark-red spots on certain portions of the external surface of the body, even in non-dependent parts. These are to be differentiated from suggillations.

Putrefaction does not take place at a freezing temperature; hence the discovery of a decomposed body in the snow or ice would afford strong evidence that the death of the subject was not the result of cold, but rather that the process of freezing had been consummated *post mortem*. In such instances the death might have been due to apoplexy, etc. Tidy says, in this connection, that "the chances are that the person did not die from cold at all, but that some days after death (that is, after putrefaction commenced) the body had been brought from a warm place to the spot where it was found. If, previously to finding the decomposed body, there had been a long continuance of cold weather, the probability that such was the case would be greatly increased."

The brain and other viscera are usually in a state of congestion. The cavities of both sides of the heart may contain large amounts of blood. The large vessels leading from it may also be in the same condition. The blood is of a bright-red color. Wischnewski,[2] who had conducted autopsies on forty-four frozen bodies, found in forty instances hemorrhages on the mucous membrane of the stomach. They appeared like little spots raised above the surface of the surrounding mucous membrane. They were rounded or oval in form, about the size of a pea, and of a dusky or blackish color. They varied in number from five to a hundred in each case. These hemorrhages were absent in cases where the person died from some other cause anterior to the freezing. The appearance of the hemorrhages was not in the slightest degree affected by the condition of the stomach in regard to being full or empty. To satisfy himself as to the reliability of this appearance as a sign of death from freezing, the author froze rats and guinea-pigs,

[1] British and Foreign Medico-Chirurgical Review, 1855.
[2] Wiener Med. Blätter, July 11, 1894.

when the same hemorrhages as appeared in man were discernible. I and young dogs frozen to death he did not observe them, but ins general congestion of the mucous membrane of the stomach. Wischr considers this sign of forensic importance, as significant of death fro posure to cold.

DEATH BY STARVATION.

Remarks—Symptoms of Acute and Chronic Starvation—Period at which occurs—Post-Mortem Signs—Accidental, Homicidal, and Suicidal Starva Medico-Legal Relations.

Starvation implies the partial or total deprivation of food from a p previously supplied with the necessaries of life. It is called acute star when the food is suddenly and completely withdrawn, and chronic whe gradually withheld. Physiology teaches that the phenomena which cl terize vitality are associated with certain chemical changes occurring i tions of the blood or tissues of the human organism itself; the preser the materials changed being harmful to the body, they are thrown eliminated by the various organs of excretion. This constant loss der an equivalent supply; therefore, life can only be maintained in the bo the existence of a constant equilibrium between its waste and repair. suggests the subject of food, which will be considered briefly.

The question, *How long a time has elapsed since a meal has bee sumed?* may be answered, in a general way, by stating that the peri the digestion of a meal made up of mixed food varies from three and half to four and one-half hours. It may, however, take six or even hours or more for the digestion of some meals; while, on the other other substances are digested within an hour's time.

The period during which a healthy adult can sustain life without and drink is usually stated to be from eight to ten days. Case on record where individuals lived on water alone for periods varying twenty to forty days. One of the most remarkable instances of v tary fasting was that of George Henry Stratton, who was the last c contestants who undertook to break Signor Succi's record of fort days and a fraction. His record is thirty-seven days, one hour, and minutes on water alone, without stimulants of any kind (something before attempted), and forty-one days, eighteen hours, and thirty mi without food of any description. During the intervening four days, s teen hours, and twenty-eight minutes, he drank a small quantity of c pagne with crushed ice. The following account of Stratton's fast is q from various reports published at the time of the exploit. The writer, the assistance of Dr. Sebastian J. Wimmer, of this city, made daily c vations.

"At nine o'clock on the evening of October 5, 1891, George H Stratton, a native of Courtland, New York, began his fast which w

lipse that of Signor Succi,—forty-five days. Stratton is a man of about irty years of age, and when he began the fast weighed two hundred and venty and three-fourths pounds. According to his own statement, he has ready fasted for a period of thirty days at Buffalo, New York, and he gives s his reason for entering upon this extraordinary task that, being of immense physique, and also suffering from some heart affection, he had been old that the reduction of his bulk would cure him of the cardiac affection that hreatened his life. It was with this idea that he entered on the thirty-day fast t Buffalo, and his success there led him to undertake the feat here. During he entire fast he has been most closely watched by a committee representing the press of New York City, and also by men purposely sworn in. Two physicians, Drs. Justin Herold and Sebastian J. Wimmer, of this city, made careful examinations twice a day. It would be utterly impossible for Stratton to obtain food, for he is constantly under the eye of one of his watchers. He usually retires at about midnight and rises at about 9 A.M. He walks about the hall, talks, laughs, and smokes occasionally. It is rarely that he does not take daily exercise in the way of using dumb-bells, etc. On the eighteenth day of fasting he weighed two hundred and forty-one pounds, eleven ounces; his temperature was about normal, his pulse 84, his hand-grasp registered on the dynamometer 105 (both hands), and his respiratory powers had slightly increased. He has taken daily doses of clysmic water, and has passed from twenty ounces to twenty-nine ounces of urine daily. On the twenty-fifth day Stratton was in pretty good shape, having ost thirty-eight pounds. At this time his temperature was 99, pulse 76, nd hand-grip 95, showing a decrease of this power. He drank twenty-even ounces of water during the day and evening. On the thirty-third ay he was taken out driving. The only complaint that he made while inaling the invigorating air was that he felt dizzy, and that the jolting over the obble-stones produced nausea. When he returned from his drive he was uite exhausted.

"From this time on his condition did not improve, and on the thirty-eventh day stimulants were added to his 'food,' which had heretofore een composed of air and water alone. Symptoms of heart-failure soon ppeared, and his fast had to come to a sudden end. He had grown so weak that he had to take to his bed. He grew so much worse that he was taken to Bellevue Hospital and placed in the alcoholic ward, in which place he expired, November 17, 1891, at 4.30 A.M."

During the fast of Stratton the writer made numerous examinations of the urine passed. The specific gravity varied from 1019 to 1034, the reaction being acid. As a whole, there was a uniform decrease in urea, this being of course, subject to some fluctuation. The bowel-movements were *nil* after the first two days. The mental condition of Stratton was splendid throughout the entire fast, and it was only when he was compelled to give up the fast that he grew melancholy and despondent. From being a perfect giant in stature, he fell away in flesh until his clothes hung limply on him, but his

complexion retained its florid and healthy hue and his eyes were bright and clear.

Persons of mature age bear prolonged abstinence from food with more ease than do those younger in years. Women are better fasters than men, on account, no doubt, of the greater development of the fatty tissues and the less activity of the muscular and nervous systems. Children are the worst abstainers of all. The period during which a person can sustain life under a total deprivation of food is prolonged by a damp atmosphere, which checks exhalation, a moderate temperature, and quiet and rest of the body; while, on the other hand, a hot, dry air, muscular exertion, and a low temperature all tend to abbreviate the period during which it can be preserved. Life is prolonged on a diet of water alone, and if this be of mineral origin the chances are still better. The vitality of the blood is maintained by the ingredients present in mineral waters, while ordinary water does not contain the necessary salts.

Death occurring solely from starvation is comparatively rare, yet there are cases of sufficiently frequent occurrence to demand investigation on the part of the legal physician. Many cases of death from deprivation of food are those in which the œsophagus has been gradually occluded by diseases of various sorts. The period during which life can be sustained without food has been greatly prolonged through the influence of mental alienation.

Symptoms.—The most prominent symptoms of prolonged abstinence from food and drink, under ordinary circumstances, apart from the sensations of hunger and excessive thirst, are pain and an inordinate craving at the stomach, night and day. The sufferings of such a person during the first two days are, perhaps, more acute than in the remaining stages. The pain in the epigastrium is relieved by pressure. This is followed by a sense of weakness and of great thirst, accompanied by nausea. The sufferer still has a craving for food, but as the loss of strength increases the eager desire for food decreases. On the fifth day the countenance becomes pale, the person's cheeks appear hollow and sunken, and the eyes possess a wild, glassy appearance. The body exhales a peculiar odor and becomes attenuated, and the sufferer's strength is about exhausted. The temperature is subnormal. The condition of the mouth is dry and the tongue is heavily coated. The breath is bad. The urine is small in amount and very acid. On the sixth day there is increased suffering, although the desire for food or the pangs of hunger are obliterated by the overpowering languor and sickness. The head becomes dizzy, and the muscular feebleness soon reaches complete inability to move about. There are tinnitus aurium, sleeplessness, with an exhibition of weakness of the mental powers. On the seventh day increased lassitude and further prostration occur. The sufferer's arms hang listlessly by his side, while the legs drag heavily. Hallucinations with delirium and convulsions frequently precede death. As a rule, death occurs as a result of the increasing torpidity. The Welsh fasting girl lived for eight days without either food or drink.

In *chronic starvation* hunger is not a very prominent symptom. In this form death often occurs as a result of disease. Emaciation, especially in the last stage, is the most characteristic symptom of starvation. The skin is dry and harsh, and covered with a brownish coat. Its smell is offensive. The eyes are sunken, and the pupils in a state of dilatation. At first the pulse is somewhat quickened, but afterwards it becomes slower. The temperature is below the normal, and the patient suffers exceedingly from extreme weakness. The voice is low and hoarse. The bowels may be constipated, or the fæces scanty and dry. (*Vide* Symptoms of Acute Stage.)

Period at which Death occurs.—*How long does starvation take to destroy life?* The period at which death occurs is influenced by several factors. Of these the condition of the body, the age, the supply of water, etc., are important. Thus, fat persons are not so susceptible to the effects of starvation as those who are lean. The power of endurance is considerably increased if the person starving be in good health. Young infants bear privation badly. (*Vide ante.*) The use of water, particularly mineral water, prolongs life if the sufferer be starving, etc.

Taylor says that "it is probable that in a healthy subject under perfect abstinence death would not commonly take place in a shorter period than a week or ten days."

Post-Mortem Signs.—These are quite characteristic. The emaciation of the body is very marked. The skin is dry and shrivelled, and there is an almost entire absence of fat beneath it. The eyes and cheeks appear sunken. The muscles are pale, soft, and wasted; in some cases they are atrophied. The brain may be congested or pale and soft. There may be an effusion of serum upon its surface and in the ventricles. The heart is occasionally found to be greatly reduced in size and void of blood. The stomach and intestines appear contracted, thin, and transparent, and the latter may be empty. The thinning of the walls has been considered a characteristic sign of starvation. There may be a reduction in size of the spleen, which may be softened. The gall-bladder is often found filled with dark and inspissated bile. The bladder is usually contracted and empty. The great vessels are generally empty. Anæmia of all of the solid viscera is always characteristic.

The anus and other channels of exit are red and inflamed. The eyes are staring and the pupils usually dilated. The conjunctivæ may have an inflamed appearance.

The post-mortem examination of Stratton, the faster, conducted at Bellevue Hospital, revealed nothing unusual. Fatty degeneration of the heart was the cause of death. Of course, many of the above-mentioned signs were more or less apparent in this case. Rigor mortis is usually well marked.

Accidental, Homicidal, and Suicidal Starvation.—Cases of accidental death from starvation are occasionally met with, as in the instances of persons buried in the earth, such as miners, or those shipwrecked, etc.

Homicidal starvation rarely occurs, while suicidal abstinence from food may be a mode of death with insane persons or those confined in prisons. These cases are, however, of rare occurrence.

Medico-Legal Relations.—Reese says that although starvation "is rarely the cause of homicidal death, it should be remembered that the law does not require the absolute deprivation of food to be proved, but only the necessary quantity and quality to be withheld, provided this has been done with an evil intention." Young children are sometimes exposed to the danger of death by starvation, by putting them in places (baby-farms) where they are improperly fed or nursed. Other cases bearing on starvation are sometimes met with in mothers who may be charged with the death of their infants by refusing them further nourishment from the breasts, or parents may be charged with causing the death of their offspring by neglecting or refusing to furnish them with sufficient food. The same holds true with regard to the treatment of servants by their masters.

Was the cause of death starvation or disease? A positive answer to this question may be possible if the legal physician considers carefully the results of the post-mortem examination, although it is important to know that the evidence of organic disease does not disprove that criminal starvation may have been the cause of death.

CHAPTER XXXIII.

PREGNANCY.

Medico-Legal Relations—The Signs of Pregnancy—Precocious Pregnancy—Late Pregnancy—Unconscious Pregnancy—Post-Mortem Pregnancy.

Medico-Legal Relations.—The subject of pregnancy is of great importance to the medical jurist; hence an accurate acquaintance with its essential signs is required for a proper understanding of the various phenomena presented.

The attention of the legal physician may be arrested in instances where a female declares herself pregnant for the purpose of defrauding the legal heirs to an estate; to extort money; to prevent or stay the infliction of capital punishment; to avoid attendance at court during a trial; to gratify the wishes of her husband for a child; for the purpose of compelling marriage, etc. On the other hand, pregnancy is often denied by women for the purpose of avoiding disgrace or to procure abortion, etc.

By the old Roman law a pregnant woman was exempted from execution, if capitally convicted, until such time after her delivery as was considered proper. The same exception obtains in most civilized countries to-day.

According to the old English law, in which pregnancy was required to be verified (*de ventre inspiciendo*), twelve matrons or discreet women were summoned to find out whether or not a woman was quick with child. At the present time the jury of matrons has been superseded by a jury of medical men or by the city's physician.

The Signs of Pregnancy.—These are usually described as (1) subjective signs, or those that the woman tells us about, and (2) objective signs, or those which are made known by the use of our various senses.

The *subjective signs* comprise the following: (*a*) suppression of menstruation, (*b*) nausea and vomiting (morning sickness), (*c*) salivation, (*d*) enlargement of the breasts, (*e*) irritability of the bladder, (*f*) leucorrhœa, and (*g*) quickening.

The absence of menstruation may be regarded as a very probable sign of pregnancy in a woman hitherto regular after sexual congress. The fact must not be overlooked that conception has taken place before the first appearance of the menses, subsequent to the menopause, and also during lactation. Pathologic conditions, in some instances, are the cause of the amenorrhœa. Rarely it happens that the menses are continued throughout pregnancy, and cases are recorded where they only occur while the woman is in this condition, being absent at other periods. Finally, women have given birth to children without ever having menstruated. Mental impressions may cause the menses to stop for one or two periods.

In cases where pregnancy is denied by the woman for purposes of deception or to procure abortion or infanticide, etc., she may stain her underclothing with blood. (*Vide* Feigned Diseases.)

The so-called "morning sickness" is a very common accompaniment of pregnancy. Nausea and vomiting usually begin at the first menstrual suppression. This sign usually persists until after quickening, when it ceases. It may, however, continue during the entire period of pregnancy. When associated with amenorrhœa, morning sickness, if it occurs at regular intervals and after eating, is a sign of considerable value. There are many instances, however, where it is entirely absent. The physician should remember that nausea often accompanies certain diseases.

Salivation, or an excessive secretion of the saliva from the salivary glands, is not of frequent occurrence. When it does appear, it is usually associated with hyperemesis.

An *enlargement and tingling of the breasts* may be present soon after conception. These signs are of no value whatever, as they may appear in women who are not pregnant, and during menstruation, etc. The enlargement of the breast due to the secretion of milk is more likely to be seen toward the end of pregnancy, although the existence of milk in this gland is not characteristic of pregnancy, since it has been observed in females who were in the non-pregnant state and in young girls.

Irritability of the bladder is a sign of no special value, as it occurs in other affections as well. It usually occurs early in pregnancy. However,

regarding this sign, Edgar[1] has this to say: "Irritability of the bladder is so constant, especially in primiparæ, in the early weeks of gestation, that some authorities attach considerable importance to this symptom when associated with that of cessation of menstruation."

Leucorrhœa is a sign of little consequence. It is common in the non-pregnant.

Quickening refers to the fœtal movements perceived by the mother, usually at four and a half months,—sometimes earlier, sometimes later. In rare instances the first perception by the mother of the child's movements may occur as early as the twelfth week. These movements may be simulated by flatus in the bowels or by contractions of the muscles of the abdominal wall. Reese[2] states that "it is a very deceptive sign of pregnancy, as it is purely a subjective symptom, and many nervous women, especially when anxious to have children, will mistake movements of the intestines and the contraction of the abdominal muscles for the motions of the child."

The *objective signs* of pregnancy are determined by inspection, touch, and auscultation. To elicit the fact of pregnancy by means of inspection, the physician should examine the face of the woman; the abdomen, together with its prominence, the curve of the spinal column, and the position of the shoulders, the woman being at the time in the erect posture; the external organs of generation; the mammæ; the condition of the urine; and the pulse.

Pigmentary deposits may be found in the face and forehead, and in the same situation irregular brownish or yellowish spots are often noticed. According to Spiegelberg, seborrhœa and eczema of the head and face are not uncommon. The face often appears flushed, and at other times sensations of heat, alternating with those of cold, are experienced by the patient.

There is scarcely any appreciable enlargement of the abdomen before the third month of utero-gestation. At about the twelfth week the uterus rises out of the pelvic cavity, with some enlargement of the lower part of the abdomen. Palpation of the pregnant uterus may be successfully performed during the fourth month. At about the twentieth week the uterus is about midway between the pelvis and umbilicus. At the end of the sixth month it reaches the umbilicus; while during the seventh month it lies halfway between the umbilicus and the ensiform cartilage. At the end of the eighth month it is parallel with the cartilage just referred to; but during the ninth month, instead of ascending to a higher point, it widens somewhat, and inclines slightly forward. It is well to recollect that enlargement of the abdominal walls may result from various diseases, such as ascites, dropsy of the ovary, ovarian tumor, retained menses, etc. Reese says that "the enlargement of the abdomen may lead to unfounded suspicions reflecting upon

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

[2] Op. cit., p. 483.

: reputation and happiness of the female." Hence to make a correct ıgnosis the greatest caution is imperative.

No changes are obvious in the external genitals and the vagina until out the fourth month. The external apparatus is more moist than usual; e labia majora and minora larger, more resisting, and open; pigmentary posits are not uncommon here. The meatus urinarius becomes prominent ıd of a reddish color, and the mucous membranes of the vulvar canal apear dark red. At about the fourth month there is an increase in length of ıe vagina; but toward the termination of pregnancy it becomes shorter gain, on account of the descent of the uterus and the process of the labor. he violet color of the vagina, owing to venous congestion, is apparent at bout the fourth week. This is termed *Jacquemin's test*, and is considered y Montgomery and other observers as a certain sign of pregnancy; still, s absence would not negative this condition. The papillæ of the vagina re also in an enlarged state, and the secretions more abundant. Hyperrophy of the muscular tissue of this canal, together with the greater bloodupply, produces a pulsation of the vaginal arteries (Oslander's sign). R. larnes considers the sinking or flattening of the upper wall of the vagina as certain sign of pregnancy during the early months.

The changes to be noted in the mammæ are in the veins of the surface f the breast, the pigmentary deposit into the areola and secondary areola, he enlargement of the glands of Montgomery, the nipple, and the character of the secretion. The enlargement of the breast usually appears early in pregnancy, and the superficial veins are distinct and enlarged at this time. At the beginning of the seventh month, or even earlier, tenseness of the skin produces striæ (silvery lines) resembling those (lineæ albicantes) of the abdomen. These lines are especially prominent in primiparæ. The darkening in the areola of the nipple is much more pronounced in brunettes than in blondes. About the second or third month pigmentations of the nipples occur. At this time the nipples are enlarged and sensitive. At the end of the sixth month colostrum can be pressed from the breasts. The glands of Montgomery, which are considered to be rudimentary glands, ten or more in number, become enlarged about this period. At about the fifth or sixth month the secondary areola makes its appearance, and in the middle of each white spot is observed a minute black point,—a hair-follicle. Palpation of the mammæ reveals the fact that they are firmer, harder, often painful, and more knotty than usual. These changes follow the growth of the fœtus. Milk does not appear in the breasts until labor or shortly afterwards. Edgar[1] says, "It is not uncommon, especially in elderly primiparæ, to oberve little or no enlargement of the mammæ, and then these women are arely able to perfectly nurse their child." Sometimes an excessive adipose ecretion about the breast is liable to be confounded with a true enlargement f that gland. (Reese.) The absence of any of these mammary signs does

[1] Op. cit.

not negative the existence of pregnancy; hence the value of the sign al is of no consequence, but, taken in conjunction with other symptoms, becomes of importance and requires careful consideration.

Kiestein in the urine, which is nothing more than a fatty pellicle wh forms on the urine of pregnant women after standing for a short time, i sign of no importance, since it is not peculiar to the urine of pregn women. Kiestein is considered by many to be composed of casein in as ciation with phosphates.

The condition of the pulse is of no special value. It remains the sa whether the pregnant woman be standing, sitting, or reclining.

The objective signs to be determined by palpation are the changes occ ring in the vagina, those in the cervix and os uteri, the size and shape the uterus, uterine fluctuation, ballottement, and Hegar's sign. The reco nition and movements of the fœtus are also determined by touch. Softe ing of the cervix uteri occurs early. In a primipara it progresses rath slowly, but in those who have already borne children it is much more rapi In the latter class one-fourth of the vaginal cervix is affected by softening four months, one-half at six months, three-fourths at seven months, and t final fourth at eight months. The external os is the original seat of t softening. Shortening of the cervix uteri occurs during the last two wee of pregnancy, but in some instances it does not become manifest until a ve short time before the actual labor begins. In a primipara the external os round instead of a slit-like aperture. It is occluded until the termination pregnancy, unless threatened abortions have taken place. Widening of t cervical canal is apparent, but the internal os is occluded until obliteration the cervix occurs. In a multipara the external os is circular in outline, a along its margins hard nodules that project are appreciable to the sense touch. These are the result of lacerations during previous labors. T cavity of the cervix is in most cases funnel-shaped.

According to Hegar, the *softening of the fundus uteri above the sac uterine ligaments* is a sure sign of pregnancy. *Ballottement* is the test f determining the presence of a fœtus or some other floating body in the liqu amnii. It can be performed as early as the fifth or sixth month of pregnanc The same sensation to the examining finger as that occasioned by a fœtu it is said, may be produced by floating tumors of the uterus. Ballotteme may, however, be prevented by the existence of multiple pregnancy, placen prævia, pedunculated subperitoneal fibroid, multilocular cysts, etc. Braxt Hicks claims that the *intermittent contractions of the uterus* at the end of t third month are valuable as indicative of pregnancy. They occur every f or ten minutes, and usually last from two to five minutes. *Uterine fluctuat* occurs at about the second month. The method for ascertaining it is by introduction of two fingers into the anterior cul-de-sac, at the same t making counter-pressure above the pubes. Basch states that it is a cer sign when taken in conjunction with amenorrhœa and the changes in areola of the nipples. The fœtus may be recognized at about five mon

and different parts of it at the end of the sixth or beginning of the seventh month, while its movements are discernible toward the end of the fifth or beginning of the sixth month. In some instances the whole fœtus moves, producing a marked change in the shape of the uterus, while in other cases there is only an appreciable movement of the head or extremities. These signs may be absent by reason of the presence of a feeble child or of hydramnios; and again, contractions of the muscles of the abdominal walls, and intestinal flatus may simulate them.

The *fœtal heart-sounds*, the *uterine*, *cardiac*, and *funic souffle*, and the *fœtal shock* are determined by auscultation. The *fœtal heart-sound* has been aptly likened to the sound produced by the tick of a watch heard through a soft substance, such as a pillow. The time for its detection is generally at five months; rarely at three and a half months. It has been heard plainly at four months, but a practised ear often fails to note the sound earlier. The frequency of the beats is from 120 to 160 per minute, the average being 140. Some authorities state that if the beats be above 134 per minute the child will be a female, and if below, a male. This relation of frequency of the beats to sex is, however, of no great importance as a sign, as no reliance can be placed upon it. The fœtal heart-sounds will be absent if the fœtus be dead. Another important point to remember in this connection is that the distinctness of the sounds is greatly influenced by the size and period of development of the fœtus, by its position, by the amount of liquor amnii present within the cavity of the uterus, and by the thickness of the abdominal and uterine walls.

The *uterine souffle* is occasioned by the rapid passage of blood in the uterine arteries. It is synchronous with the beats of the mother's pulse, and may be heard for some days after the birth of the child. The quality and intensity of the uterine souffle bear a close resemblance to the bruit of an aneurismal tumor. The site at which it can be heard with ease is at the lower segment of the uterus, being more distinct on the left than on the right side. Sometimes it is possible to hear it over any portion of the organ. It can be detected as early as the tenth week, but better from the fourth to the seventh month. This is not an important symptom of pregnancy, inasmuch as it may be heard in uterine fibroids, in enlargement of the uterus from any cause, as by tumors, etc., and in some tumors of the ovary. The *cardiac souffle* is produced by the circulation of the blood through the foramen ovale. It is of no value as a sign, nor is the *umbilical souffle*, which is caused by pressure upon the umbilical cord. The *funic souffle* consists of a single bellows murmur, synchronous with the fœtal heart-beats; it is heard over a very limited space, and is more difficult to distinguish than any of the other sounds. The so-called *fœtal shock* can be heard about the middle of pregnancy. The impression that is conveyed to the ear is that of an instantaneous tap, succeeded by a rapid bruit.

Among the miscellaneous symptoms or signs of pregnancy may be mentioned the enlargement of the thyroid gland; pigmentation on the

face and arms; diarrhœa; frequent micturition; unnatural cravings certain kinds of food, etc.; pain, which, however, is not always prese varicosities and œdema of the lower limbs; rectal disturbances; plethor hypertrophy of the heart, with stronger pulse; occipital headache; alte tions in character, temper; alterations in appetite, etc.

The most certain signs of pregnancy are (1) the fœtal heart-sounds, (the movements of the fœtus, and (3) the recognition of the fœtus.

The *duration of pregnancy*—that is, the period between insemination a labor—is two hundred and seventy-five days. When calculated between t last time of menstruating and the commencement of labor it is two hundr and seventy-eight days.

The following cases, with some practical questions of medico-legal terest, are abridged from Dr. David W. Yandell's interesting paper,[1] pu lished in the *Journal of the American Medical Association* for August 1890:

Case I.—A., aged nineteen years, suffered from an abdominal tumor four months. It was pronounced, after a thorough examination by t medical men, to be a gravid uterus. The patient indignantly denied this sertion, but the most deplorable family feeling followed. The mistake w not discovered until the lapse of eight months, and an ovarian tum weighing one hundred and nineteen pounds, was excised.

Case II.—B., a widow, married four years, but without childre Twelve months after her widowhood she was sent to me for the removal an ovarian tumor. Two months later she gave birth to a healthy ma child. The mistaken diagnosis of the physician in the first case occasion the most profound grief to a large number of excellent persons. The err of the doctor in the second case saved the woman from disgrace, for, bei sent a long distance from home to have the foreign body removed, the co finement was kept a secret.

Case III.—C., a healthy woman, married a medical man who was an i valid. The couple separated after having lived together for three year They had no children. The woman subsequently married a healthy an vigorous man. Five months later the abdomen showed signs of enlarg ment, and the woman was overjoyed at the prospect of being pregnan She fancied that she had all of the usual symptoms indicative of pregnanc Menstruation ceased, and she engaged her family physician for the comi event. After eight months had elapsed the abdomen grew enormousl What was claimed as labor-pains, a month later, was sufficient to summ doctor and nurse to the woman's side. During the physician's examinati of the woman a severe pain occurred, and was followed by a great gush waters. The abdomen collapsed, and the supposed pregnancy was ter nated.

[1] Read in the Section of Medical Jurisprudence at the Forty-first Annual Me of the American Medical Association, Nashville, May, 1890.

CASE IV.—D., a healthy young female, newly married, had at the expi-
ation of five months all the signs of pregnancy, both natural and physical.
t the end of what should have been the full term she experienced a gush
water minus a fœtus, and a collapse of the walls of the abdomen, as in the
-mentioned case. "The question of responsibility in the diagnosis and
tment of such cases," says Dr. Yandell, "is one in which the best judg-
t and skill may be mistaken. Some general facts which should govern
ese cases are as follows: 1. The diagnosis must rest on a group of well-
rved facts which, in all ordinary judgment, can admit of no other pos-
meaning. 2. If the facts are uncertain and the conclusions admit of a
t, it is the duty of the physician to submit the question of responsi-
to the family and share it with some one, otherwise he will be culpable.
he physician is only responsible for the exercise of the best judgment
skill he may possess. He cannot be accountable for errors of judgment,
ss they were from want of proper care and diligence, which were in his
er to have used. He is also bound to anticipate and provide for the pos-
consequences which might follow from a mistake of diagnosis and treat-
t. 4. The physician is expected to use all care and diligence, and take
for reflection in determining the diagnosis, which should be based on
preponderance of facts and their most probable natural meaning. The
sician is held liable if he neglects the exercise of ordinary skill and fore-
ght in both the treatment and counsel to the case. 5. Finally, the
sician is liable if he subjects the patient to peril of life or reputation by a
diagnosis or operation. If he assumes a certain amount of knowledge
is not sustained by the facts of both in this and other cases, he is liable.
physician who undertakes the care and treatment of cases of abdomi-
tumors is assumed to possess skill and exercise care beyond that of the
nary physician. He is liable for carelessness, neglect, ignorance, and
ssions to study the facts in such cases carefully, and make a reasonable
nosis, on which to conduct a reasonable treatment."

Precocious Pregnancy.—Instances of early pregnancy are related by
ous authors. Tidy refers to the case of a girl who menstruated at four
s of age and became pregnant at eight years. Other instances are
rded by different writers; thus, in a case mentioned in the *Lancet*
ril, 1881), a girl of eight years and ten months gave birth to a child
hing seven pounds. Another similar instance is reported by Dr. C. W.
ves, of Virginia,[1] as follows. "Annie H. was born in Bland County,
inia, July 15, 1885, and September 10, 1895, she was delivered of a
formed child weighing five pounds. The girl has no developments of a
an, although she has menstruated regularly since she was five years
The labor was a short and uneventful one, and two hours afterwards
child-mother wanted to get up and dress, and would have done so had
been permitted. There were no developments of the mammæ or secre-

[1] N. Y. Medical Record, November 16, 1895.

tion of milk; the baby was nourished through its short existence (as it only lived a week) by its grandmother, who had a child only a few months old. The parents of this child, Mr. and Mrs. J. P. H., are prosperous, intelligent, and worthy people, and there is no doubt of their child's age. The child is now well, and plays about with the other children as if nothing unusual had happened."

With respect to *late pregnancies*, there are some recorded instances where women brought forth children as late as fifty and sixty years. Such cases are not uncommon. There are reports of pregnancy occurring at the age of seventy; but as they are not well authenticated, no reliance can be placed upon them. Two cases of labor, one at sixty-three and the other at seventy years of age, are mentioned by Halles.[1]

Unconscious Pregnancy.—*Can a female become pregnant unconsciously?* There can be no possible doubt of such an occurrence; hence the question must be answered in the affirmative. It is a well-known fact that women are often ravished when unconscious through narcotism, etc., and bear children as a result of such intercourse. Artificial impregnation has also proved successful in more than one instance. Brouardel[2] states that intercourse and impregnation may occur in a woman without her knowledge during hypnotic sleep. Reese[3] says, "That a woman should be unconscious of the fact of sexual intercourse, and also continue unconscious of the resulting pregnancy up to the birth of her child, we decline to believe, unless she was feeble-minded or idiotic. Cases of this character frequently occur in unmarried females, who are wont to protest most earnestly their utter ignorance of the whole affair, and who pretend to ascribe the pangs of labor to colic or some other disorder, and who, when the child is shown them, will positively deny all knowledge of its origin. With married females the case is quite different. With them unconscious pregnancy is a very possible occurrence. Many instances might be adduced of married women who, having had no children for several years, on becoming actually pregnant, refused to recognize their true condition, ascribing their increase of size to dropsy or some other disorder."

Pregnancy in the Dead.—Here the question of the identity of a body may arise, and it may be found obligatory on the part of the medical examiner to ascertain the fact of pregnancy *post mortem* in order to prevent charges of unchastity being made against the deceased person. As has already been pointed out (*vide* Phenomena and Signs of Death), the uterus will resist putrefaction longer than any other organ in the body, even months after interment; therefore, the question as to whether a woman died pregnant or not ought to be easily decided. In a case mentioned by Casper and quoted by Reese,[4] a young man was charged with the seduction and murder of a young woman whose remains were discovered, nine months

[1] Manuel complet de Médecine légale, p. 137.
[2] Gazette des Hôpitaux, 1877. [3] Op. cit., p. 488. [4] Op. cit.

after her disappearance, in the vault of a privy. The body was entirely decomposed, with the exception of the uterus, which was found to be firm and perfect, and in an unimpregnated state, proving conclusively that the person suspected of foul play was entirely guiltless of the death or supposed seduction. This case illustrates the importance of becoming thoroughly acquainted with the signs necessary to rebut suspicions such as the instance just referred to elicited. On the other hand, if the woman really died while in a pregnant condition, and the fœtus had advanced to the time when ossification began, traces of its bones may be found years after the burial of the mother. This discovery would, of course, be positive proof of the existence of pregnancy.

CHAPTER XXXIV.

CRIMINAL ABORTION.[1]

Spontaneous or Natural Abortion—Artificial (Therapeutic or Criminal)—Means employed to procure Abortion—Diagnosis—Age of the Fœtus—At what Stage of Pregnancy has the Abortion occurred?—Sequelæ—Duties of the Medical Examiner in Cases of Criminal Abortion—Signs afforded by the Mother—Examination of Substances expelled from the Uterus—Examination of Instruments, Drugs, etc., in Possession of the Suspected Individual—Tabular Statement for Reference—Medico-Legal Bearings.

Abortion, in medicine, signifies the expulsion of the product of conception before the sixth month of utero-gestation,[2] or anterior to the time that it is viable. After this period it is called a premature birth. An abortion is said to be "incomplete" when the fœtus is expelled without the membranes or placenta. The term, as employed in law, is understood to refer to the premature expulsion of the contents of the uterus before the full term is reached. Abortion may be classified as that which is of *spontaneous origin*, and that which occurs as the result of *artificial means*. Artificial abortion is further subdivided into that which is *therapeutic* or *justifiable*, and that which is *criminal* or *unlawful*.

"The interests of society have suffered, and in a measure are still suffering," says Tidy,[3] "from such words as 'animate' and 'inanimate' being applied to the fœtus, and from the absurd attempts to fix a period when vitality begins. Thus it has been stated by some that life begins on the third, and

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[1] *Vide* "Criminal Abortion," by Justin Herold, A.M., M.D.

[2] Abortion is usually divided into ovular (during the first three weeks), embryonic (up to the fourth month), and fœtal (after the fourth month). Some authorities apply the term *abortion* to those cases where the ovum is expelled during the first three months, and the term *miscarriage* where the uterine contents are expelled subsequent to the third month up to the time of viability.

[3] Op. cit., vol. iii. p. 96.

by others on the seventh day after conception. Forty days (Galen), sixty days (Zacchias), the period of quickening, and the period of birth (the Stoics) have each had their advocates as the advent of the first life. Some have held that the time of commencement of vitality in boys differs from that in girls, Hippocrates fixing the thirty-second day for the male and the forty-second for the female, while others, with equal reason, have fixed the fortieth for the male and the eightieth day for the female." These questions are, however, of no importance to the modern physiologist, who regards them as entirely erroneous, since an absolutely independent life is created at the moment of the fusion of the germs of both the male and the female parties; or, in other words, vitality is established with the act of impregnation. Proofs of this assertion are shown in the vital phenomena of cell-proliferation, differentiation, nutrition, and organization as witnessed after impregnation has once been effected.

For the purposes of this chapter the subject under consideration will be discussed as natural or spontaneous abortion, artificial or legitimate, and criminal abortion.

Natural Abortion.[1]—Abortions which originate spontaneously usually take place in the first three months of utero-gestation. The frequency with which they occur is variously stated at from one in five to one in ten pregnancies. As a general thing, it may be stated that this form of miscarriage occurs at a time corresponding with what would have been a regular menstrual period or monthly flow. The *causes* of spontaneous abortion may be divided into the paternal, maternal, and ovular. Of the *paternal* etiological factors, syphilis, alcoholism, sexual excesses, extreme youth or old age, exhausting chronic affections, etc., are most prominent. The *maternal* causes are divided into those which are external and those which are internal. The former arise from violent exercise, accidental or intentional traumatisms, surgical operations, tight lacing of corsets, coition, pressure upon varicose veins, high altitudes, and hot baths and hot vaginal douches. The internal causes are: (1) infectious diseases of an acute nature, with miscarriage due to high temperature, hemorrhagic endometritis, and infection of the fœtus; (2) syphilitic or other chronic affections; (3) displacements of the uterus, or inflammations, such as endometritis, and structural disorders; (4) pelvic adhesions; (5) organic diseases of the kidneys; (6) vomiting, diarrhœa, dysentery, sneezing, or coughing; (7) mental emotions; (8) tumors, etc. The *ovular* causes of abortion are such as occasion the death of the embryo or fœtus, as diseases of the decidua or placenta, polyhydramnios, placenta prævia, infectious diseases, compression of the umbilical cord, etc.

The liability to the recurrence of abortion[2] is manifested in some women, although *habit* is not to be regarded as an etiological factor. The *symptoms*

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[1] The term "missed abortion" is used to signify that a dead fœtus has not been expelled from the uterus within two weeks.

[2] *Vide* p. 467.

abortion are classified into those which are premonitory and those which are characteristic. The *premonitory symptoms* are usually present subsequent to the second month. They are a sense of weight and fulness in the pelvis, uneasiness and painful sensations in the lumbar and sacral regions, irritability of the rectum or bladder, alternate sensations of heat and cold, and a feeling of general malaise. There is also an increase of the vaginal secretions. Of the characteristic signs of abortion, hemorrhage and painful contractions of the uterus are the most significant. The latter are produced by uterine congestion and by the expulsion of blood-clots. In those cases of abortion occurring during the first two months of gestation there is a marked resemblance existing between them and a profuse monthly menstrual flow, associated with dysmenorrhœa. These signs generally last for several days, usually four or five at least. The germ, as expelled from the uterine cavity, is surrounded with clots of blood, or it appears in fragments along with the decidua. In most instances occurring before the fourth month, the ovum is expelled entire; but at a later period there is rupture of the ovum, with expulsion of the fœtus, the appendages being retained for a variable length of time. The proximity of the abortion to the seventh month lessens the liability to hemorrhage, and the uterine decidua is more readily expelled than in those cases which are of early appearance. Subsequent to the formation of the placenta, hemorrhage is from the placental site; while anterior to its formation, the bleeding originates from the surface of the cavity of the uterus.

The great and *immediate dangers* of abortion are *hemorrhage*, *septicæmia*, and, rarely, *tetanus*;[1] while those which are remote in their nature are *chronic parenchymatous metritis* (subinvolution), *placental polypus*, and *uterine displacements*.

A commencing abortion is detected, as a rule, by the evident uterine contractions, hemorrhage, dilatation of the cervix uteri, and appreciation of the ovum on palpation.

The conditions which produce unavoidable abortion are death of the fœtus, detachment of the ovum, and rupture.

Treatment.—The reader is referred to the various larger works on obstetrics.

The subjoined outline of the causes of natural abortion, after Barnes, is taken from Witthaus's "Medical Jurisprudence, Forensic Medicine, and Toxicology," vol. ii. p. 110.

Maternal Causes.

I. Poisons in Mother's Blood.

(1) Communicated.—*Heterogenetic:* fevers, malaria, syphilis.
Gases, as CO, CO_2.
Minerals: lead, copper, mercury.
Vegetable substances: ergot, savine.

[1] *Vide* "Tetanus," by Justin Herold, A.M., M.D. (American Medico-Surgical Bulletin, August 1, 1895).

(2) Products of morbid action.—*Autogenetic:* as in jaundice, albuminuria; CO_2 from asphyxia, and in the moribund.
(3) Anæmia, over-suckling, obstinate vomiting.
Bright's disease, lithiasis, jaundice.

II. Diseases disturbing the Circulation dynamically.

Some liver diseases, obstructing portal system.
Heart diseases, excess of vascular tension.
Lung diseases, thoracic and abdominal tumors.

III. Causes acting through the Nervous System.

Some nervous diseases.
Shock, physical and psychical.
Diversion or exhaustion of nerve-force, as from vomiting.
Reflex action.
Convulsions, apoplexy (these last two act partly through asphyxia, producing CO_2 in the blood).

IV. Local or Pelvic Disease.

Of uterus, as inflammation, hypertrophy, tumors, diseases of decidua.
Mechanical anomalies, as flexions and versions of uterus, fissures of cervix, pressure of tumors on uterus, or adhesions of uterus preventing its growth.

V. Adolescent and Climacteric Abortion.

Uterus immature (infantile) or
Uterus in atrophic involution (senile).

VI. Artificially caused by Violence.

Blows, squeezing, puncture of uterus, injury to ovum.
Epidemic abortion.
Sympathetic abortion.

Fœtal Causes.

I. Diseases of Ovum.

Primary or secondary upon diseases of maternal structures or blood.

II. Diseases of Embryo, generally causing its Premature Death.

Faults of development.
Diseases of nervous system.
Diseases of kidneys.
Diseases of liver.
Diseases, general, as syphilis.
Mechanical, as torsion of cord, or anything causing death of embryo.

Artificial Abortion.—This is an act calculated to prevent the birth of a live child, and it may be either legitimate or criminal. It is *justifiable* in those cases where it becomes necessary to save the life of the mother, as the longer continuance of the pregnancy would be fatal. Such cases are: (1) where the patient suffers from nephritis; (2) uncontrollable vomiting; (3) where extreme contraction of the pelvis exists; (4) where there is placenta prævia; (5) severe hemorrhage; (6) neoplasms in the birth-canal; retroversion or retroflexion of the uterus, with incarceration; (7) procidentia

ch are irreducible; diseases of the heart and lungs when the symptoms peculiarly serious; (8) rupture of the uterus; and (9) diseases of the um.

An abortion, when necessitated by pelvic deformity, or, in fact, any sci-tific reason, should not be undertaken without the formal consent of the man herself, or of her husband or guardian. This should be obtained in iting if possible. The operator should also consult with another physician fore assuming such a responsibility.

If the operation is indicated on account of any pelvic narrowness or de-rmity, the following table, after Lusk, which furnishes the measurements f the pelvis, will be of assistance to the operator in determining the latest eriod at which abortion may be performed:

Antero-posterior Diameter of Pelvis.	*Latest Period for inducing Abortion.*
One and a half inch.	Beginning of sixth month.
One and a quarter inch.	Beginning of fifth month.
One inch.	Four months and a half.

The principal methods of inducing abortion are: (1) the introduction of tupelo, or sea-tangle tents, within the cervical canal; (2) the puncturing of the membranes and the partial separation of the ovum with a uterine sound; (3) the passage of a flexible bougie between the membranes and the uterus; (4) irritation of the mammæ; (5) injections of hot or cold water, or both alternately, within the vagina or uterus; and (6) applications of faradic or galvanic currents of electricity through the uterus; if strong and frequently repeated, they produce abortion at any period of gestation. The dilatation of the cervix uteri and the expulsion of the uterine contents by means of a curette and uterine forceps are effective in skilful hands in the first two or three months of pregnancy. This operation may be completed within fifteen to twenty minutes.

Late Abortions.—Those necessitated after the fifth month are induced by methods similar to those employed in premature labor. For pelvic deformity or neoplasms the following table,[1] after Charpentier, will outline the conduct of the case:

(1) Pelvis of 3.5 inches. In a *multipara*, labor should be induced at eight months one week to eight and a half months. In a *primipara*, wait until full term, or do not induce labor until eight or ten days anterior to the term.
(2) Pelvis of 3.3 inches. At eight to eight and a half months.
(3) Pelvis of 3.1 inches. Between eight and eight and a half months.
(4) Pelvis of 2.9 inches. Between seven and a half and eight months.
(5) Pelvis of 2.7 inches. Between seven months and seven months three weeks.
(6) Pelvis 2.5 to 2.3 inches. At seven to seven and a half months.
Abortion should be performed when the pelvis is below 2.3 inches.

[1] The pelvic measurements refer to the antero-posterior diameter of the inlet.

In those cases requiring the induction of abortion subsequent to the fifth month, the prognosis should be guarded, for the liability to puerperal diseases is great. (*Vide* any of the larger text-books on obstetrics for a more detailed account of these operations.)

Criminal abortion is the unlawful expulsion of the ovum, fœtus, or child from the uterus at any period of pregnancy; or, in other words, it is criminal delivery prior to maturity. (*Vide* Medico-Legal Bearings at end of chapter.) This crime is closely allied to that of infanticide, and is looked upon by all law-abiding people as a most heinous one.

The practice of abortion is not of modern introduction, for from history we learn that it was performed from time immemorial. Ovid, Seneca, Aristotle, and other ancient writers refer to its prevalence during their time, while the earlier Christians vehemently denounced its practice. During the Middle Ages it was very common in Europe, while it still prevails among the Mohammedans, Japanese, Chinese, and Hindoos. At the present time it is extensively resorted to among savage and semi-civilized nations, not to speak of its practice by the inhabitants of the most civilized countries of the earth. The act is generally committed either from an unrestrained desire to kill the product of conception or to obliterate the traces of pregnancy. It is not infrequently attempted or induced by the pregnant woman herself. Unfortunately, these women do not seem to realize the enormity of the crime, or else they are not always familiar with the fact that their act is criminal and amenable to punishment, just the same as if the abortion were procured by another.

Means employed to procure Abortion.—The general means by which abortion is induced (criminally) include: (1) the application of violence, such as great pressure upon the abdomen or back, or violent exercise on the part of the pregnant woman, and (2) repeated bloodletting, emetics, and purgatives. The *special means* comprise the employment of reputed abortifacients, such as various metals and their salts; vegetable preparations, such as savine, ergot of rye, tansy, yew, saffron, pennyroyal, etc.; and mechanical injuries inflicted on the uterus and its contents, or other local measures, such as irritating applications to the vulva, vagina, or os uteri.

Abortion may also be produced by means originating in the mind of the guilty person at the time of performing the operation. Among the savage or semi-civilized nations we find implements used for this purpose which are of the most primitive type. In fact, as Cameron says,[1] "the ruder the nation, the rougher and more primitive are the means employed." Of the *mechanical measures* employed in attempting or producing criminal abortion may be mentioned the following: tight lacing, intentional falls, muscular strains, horseback riding, driving over rough roads, long walks, etc. Repeated bloodletting and leeching are often resorted to, but they generally fail to effect the desired result. Their action is supposed to suddenly de-

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology.

ase the circulatory effect of the blood-elements in the placenta, thereby erfering with the normal nourishment of the child. Mechanical means y, subsequent to the first two months of utero-gestation, show their effects destroying the vitality of the fœtus, and thereby produce abortion. olent exercise or brutal violence may result in an abortion by causing a turbance of the relative positions of the ovum and uterus. The signs of ernal violence are frequently so evident that considerable light may ereby be thrown upon the case. The marks resulting from the application leeches to the anus, vulva, etc., would also be readily observed.

Of the modern methods most employed by professional abortionists may mentioned that of dilating the uterus with graduated dilators under an esthetic, and immediately emptying it, with antiseptic precautions. This thod is adopted by those physicians who have proved false to their ble vocation. Such operators usually practise their nefarious trade in ll-regulated private hospitals, so that the chances of detection through y ill effects of the operation are comparatively *nil*. There are others, wever, who are ignorant and unskilled, and who include in their arma-ntarium instruments of great variety. These instruments consist of erine sounds, bougies, catheters, tents of sponge, sea-tangle, or like ma-rial, wire, whalebone, etc. Others still make use of such implements as e twig of a tree, a knitting-needle, a weaver's spindle, hair-pins, stilettos, n-holders, wooden skewers, umbrella ribs, crochet-needle, quills, tooth-cks, scissors, etc. The pregnant woman often attempts to introduce the strument herself, but as a general thing she suffers serious injury as a sult of her effort.

Irritating applications are sometimes made to the external organs of gen-ation, while various kinds of irritating tampons, etc., have been introduced to the vagina or applied to the external os of the uterus for abortifacient fects. Maschka states that various kinds of fluids have been injected rectly into the uterine cavity, with the object of producing separation of e membranes from the uterine wall. The dried leaves of tobacco are quently resorted to by the women of Constantinople; in fact, the methods ployed for procuring abortion are so numerous and widely diverse in aracter that to enumerate them all would reach beyond the limits of this apter.

"When the membranes are ruptured and the liquor amnii flows away, ortion generally follows sooner or later. It is not so much the passing of instrument into the uterus and the interruption of gestation which en-ngers the woman's life as it is the hurry, inexperience, and ignorance of e operator or the filthiness of his hands or instruments. In competent nds and with a proper technique the most serious operations may be un-rtaken upon the pregnant as well as upon the non-pregnant uterus, with mparatively little risk to the patient. The induction of abortion is not a ious operation, and need not entail any special risks to the patient; but ere is a great difference in the ease with which abortion is induced in differ-

ent women and in the time which is required with the same measures. It is unsafe, therefore, to apply general rules to specific cases. After the liquor amnii has drained away, abortion may occur in twenty-four hours, or perhaps not for days, or even weeks."[1]

Of the *drugs* used to bring about abortion, emetics and purgatives have been largely employed, and with varying success. Almost every variety of these drugs has been tried. Their power of action seems to be due to the inherent qualities which they possess of producing uterine contraction.

Other medicinal measures are ergot, tansy, cotton-root, savine, borax, cimicifuga, wormwood, apiol, hellebore, juice of bamboo-leaves, iron, and other metals. Epsom salts, arsenic, corrosive sublimate, quinine, cyanide of potassium, lignum vitæ, oil of amber, mugwort, cantharides, juniper, milk-hedge, camomile, squills, sodium salicylate, pilocarpine, horehound, yew, carrot-seeds, broom-fern, elaterium, chirata, molline, sassafras, digitalis, gamboge, croton oil, grains of paradise, and hiera picra. Criminal abortions are occasionally attempted by means of carbonic dioxide, bisulphide of carbon, and illuminating gas. Most all of the agents just mentioned are capable of producing a miscarriage only when the attachment that exists between the ovum and uterine wall is insecure. A few of the drugs most frequently employed for abortifacient purposes will be specially mentioned. *Ergot*, or spurred rye, possesses ecbolic properties. It excites uterine contractions, and acts directly on the vitality of the fœtus by a depressing action on the heart. In medicine it is used in the form of powder, tincture, or fluid extract. It is also used as the watery extract (ergotin). In poisonous doses it produces paralytic symptoms. According to Wood, it has caused fatal abortion, but he states that he is familiar with but two cases of poisoning in non-pregnant females. Doses of fifteen grains cause nausea and vomiting, increased peristalsis, and purging. There is a sense of fulness in the stomach and considerable epigastric uneasiness. In doses of two drachms, in addition to the symptoms just cited, there are dryness of the throat, dilatation of the pupils, dizziness, pain in the abdomen, slow pulse, together with delirium, coma, and dissolution. According to Schroff, three to eight grains of ergotin have produced a slowness of the pulse equal to eighteen to twelve beats to the minute. Abortion is sometimes caused in an indirect way, as a result of the use of this drug, by depressing the fœtal circulation.

The question as to whether ergot can *originate* the contractions of the uterus is *sub judice*, although Jewett[2] states that he has "occasionally seen evidence of its influence as an abortifacient, even in the early months of gestation." It has the quality, however, of increasing the power of already existing contractions. The dose of the crude drug is from one-half to two drachms; of the extract, which is five times as strong as the fluid extract, the quantity for administration internally is five to fifteen grains; of the fluid extract, from one to two fluidrachms, three times a day. Powdered ergot

[1] Cameron, op. cit. [2] Hamilton's System of Legal Medicine, vol. ii.

ossesses a faint, fishy smell, which is greatly enhanced when rubbed with a olution of potassic hydrate. When the drug has been taken in this form, it may be readily recognized by the aid of the microscope, the various particles ppearing as reddish deposits upon the gastric and intestinal mucous memranes. The detection of the tincture or fluid extract after administration is well-nigh impossible, the same holding true with regard to ergotin. Ergot s occasionally administered hypodermatically, a point which is sometimes f importance for the medical examiner to remember.

Tansy (*Tanacetum vulgare*) is quite popular as an abortifacient. This lant is possessed of a volatile oil and a bitter principle (tanacetin). It is ften employed as a stimulating emmenagogue, but it is an extremely dangerous remedy to use. It is a gastro-intestinal irritant and diuretic, and in arge quantities produces fatal results from paralysis of the respiratory funcion. Death is generally preceded by epileptiform convulsions of cerebral origin, and unconsciousness. In some instances it occasions a profuse salivation, while in others there is experienced a numbness and pricking of the limbs or dilatation or immobility of the pupils. One drachm of the oil has caused death. The minimum fatal quantity is unknown. The dose of the oil is one minim, while that of the infusion is from ten to twenty-five grains.

Savine (the tops of the *Juniperus Sabina*). This plant contains a volatile oil, and when applied to the epidermis acts as an irritant. In medicinal doses it produces an increase of the circulation and acts as a diuretic. It is also a gastric and uterine irritant, and in overdoses causes great depression, gastro-intestinal irritation, insensibility, convulsions, bleeding from the kidneys and uterus, suppression of the urine, and occasionally, in pregnant females, abortion. Collapse is the cause of death. This drug has been successfully employed in the treatment of both amenorrhœa and menorrhagia, when occasioned by an atonic state of the uterus. Savine is a popular abortive, but death from peritonitis and gastritis has occurred without expelling the product of conception. It is an exceedingly dangerous drug, and is generally used as an abortifacient in the form of the decoction or of an infusion of the leaves, but the oil or tincture is sometimes administered. The odor of the drug is readily recognized in the urine, and sometimes that of the oil in the blood and cavities of the body. Post mortem, the stomach-contents will consist of a greenish-like pea-soup if the drug was taken in the form of the powder or decoction. The medicinal doses are as follows: of the powdered leaf, ten to fifteen grains; of the tincture, one-half to one drachm; and of the oil, five to ten minims, every three or four hours. The fluid extract is administered in doses ranging from five to ten minims.

Yew (*Taxus baccata*) has been employed as an abortifacient with some success. As a rule, however, death occurs without any expulsion of the uterine contents; therefore its success as an abortifacient is disputed. The leaves and berries cause symptoms of irritant poisoning, followed by unconsciousness and convulsions.

Saffron (*Crocus sativus*). In the form of the decoction it is a popular

abortive; but the stigmas of the flowers of the plant—the parts employed—have not been shown to possess any uterine-excitant powers.

Pennyroyal (*Mentha pulegium*), in the form of the infusion, has been used as an emmenagogue and ecbolic, but without much success. It appears to have no apparent effect upon the uterine fibres.

Gossypium, the root of the cotton-wood plant, is largely used by the negroes in the South as an abortifacient, in the form of the decoction. Its action has been likened to that of ergot.

Tobacco, by some, is stated to possess abortive properties, but its effect on the uterus is questioned.

Rue (*Ruta graveolens*) has a somewhat decided action upon the uterus. It is usually employed in the form of the powder, the essential oil, or the infusion. In poisonous doses it causes faintness, vertigo, and at the same time acts as a powerful vascular depressant. The sufferer complains of nausea, and vomiting is of frequent occurrence. Other symptoms are salivation, severe gastric pain, jactitation, stupors, and chills. Two days after the toxic effects of the drug are shown there is usually expulsion of the contents of the uterus. The doses, medicinally, are: of the powder, one-half to one drachm; of the oil, one to five minims; and of the infusion, five to thirty grains.

From what has been said concerning the action of the various abortifacients just cited, it will be noticed that, as a rule, it is very uncertain, ergot being about the only drug possessing true ecbolic powers. Cameron[1] says "that when abortion follows the use of other drugs, the effect is attributable to the systemic disturbance caused by general poisoning rather than to any specific or primary effect upon the uterine muscle or lumbar centres. Thus any poison may become an abortifacient, the destruction of the fœtus or its expulsion from the uterus being one of the train of symptoms resulting from general poisoning."

Electricity in the form of galvanism or faradism has been used for the production of uterine contraction, and, according to Rosenstirn,[2] abortion has followed an electrical bath. In the United States this mode of procuring abortion is quite frequently employed, although the effects of the current are not always decided.

Diagnosis.—This depends upon the signs afforded by the mother, both *ante* and *post mortem*, the examination of substances and discharges expelled from the uterus, and other evidences, such as those afforded by stains upon the clothing or bedding. These subjects will be treated of under their respective headings, together with other diagnostics of abortion. It is not, as a general thing, difficult to determine that a miscarriage is in progress; but it is quite different when the medical examiner is called upon to determine with any degree of certainty, from the examination of the woman *ante mortem*, whether or not the abortion was criminal in character.

[1] Op. cit.

[2] Virchow's Jahresbericht, 1881, ii. 562.

Age of the Fœtus.—The probable uterine age of the fœtus is established from data furnished by its gradual development and appearance at the various stages of its growth. A brief consideration of the arrangement of the membranes at certain periods of pregnancy will, therefore, suffice to acquaint the legal physician with the growth of the ovum. (*Vide* obstetrical works for a more minute description of these various phases.)

From *fourteen to eighteen days* the embryo has the appearance of a flocculent mass, consisting of a semi-transparent gelatinous substance about two and one-half lines in length.

At the *third or fourth week* the embryo measures about four to six lines in length, its weight being twenty grains. Its form is curved, the extremities being indicated by little wart-like projections. The cleft of the mouth can be seen in the head, also the eyes, which are indicated by two points. The heart can also be distinguished, and the liver is noticed to be very large, disproportionately so. The size of the ovum is about that of a pigeon's egg. The chorion is formed on all sides, the embryo being attached to it by a very short cord. The umbilical vesicle is present.

At the end of the *eighth week* (second month) the embryo is fifteen to eighteen lines in length, its weight being two to five drachms, and its size equal to that of a hen's egg. It is no longer curved, and the cavities of both the nose and mouth are seen to be separated. The umbilical vesicle has disappeared. The head forms about a trifle more than a third of the body. The abdomen is closed. The sex may occasionally be discerned. The extremities are developed, but joined together, and the fingers and toes are as minute excrescences. Ossification has begun in the inferior maxilla, clavicle, ribs, and bodies of the vertebræ. There are rudimentary genital organs.

At the *twelfth week* (third month) the size of the ovum equals that of a goose-egg. Its weight equals one to two ounces, and it is two and a half to three inches long. The fingers are separated, but the toes are still joined together; the genital organs are very prominent. There is a perfectly distinct neck between the head and thorax, but the eyes and mouth are closed. The nails can be distinguished on the fingers and the sex be recognized. The placenta is developed, and the umbilical cord inserted near the pubes. The muscles begin to be noticeable at this time. The thymus and supra-renal capsules are formed, and the cerebrum, cerebellum, medulla oblongata, and the cavities of the heart are recognizable. Ossification in the cranial bones and diaphyses of the limbs.

At the *sixteenth week* (fourth month) the length of the fœtus is from five to seven inches, the weight six to seven ounces. The skin is of a rose color, very delicate, and covered with a fine down. The hair on the head is short and silvery. The sex is differentiated, and the face begins to appear characteristic. Fat is formed in the subcutaneous tissue. The duodenum contains a whitish meconium. The liver is not so disproportionately large, and the gall-bladder is developed. The scrotum and labia are formed, and

the anus is open. About the middle of the month the calcaneus begins to ossify. The disproportionate amount of liquor amnii begins to disappear at about this month, the fœtus occupying almost the entire cavity of the uterus.

At the *twentieth week* (fifth month)[1] the skin of the fœtus is of a bright-red color; it is also quite thin, but possesses considerable consistence. At the end of the fifth month the weight of the fœtus is from eight to ten ounces, while the length equals from eight to ten inches. The nails are distinct. The head is disproportionately large, about one-fourth of the body. Meconium appears, stained with bile. The point of insertion of the umbilical cord, which previously was nearer the symphysis, is farther off from the pubes. The convolutions of the brain cannot, as yet, be identified. The heart, liver, and kidneys are rather large when compared with the other organs. If abortion takes place at this time, the membranes are generally ruptured first, when the fœtus is expelled.

At the end of the *twenty-fourth week* (sixth month) the head of the fœtus is relatively not so large as was noticed in the earlier months. The lanugo and vernix caseosa are formed. The skin is thicker and of a cinnabar-red color. The hair is much more abundant. The meconium is of a dark color, and the skin is covered by sebaceous matter. The umbilicus is a trifle above the symphysis pubis. Between the folds of the skin are observed small quantities of fat. The head is very soft and the fontanelles widely separated. The color of the palms of the hands and soles of the feet is purplish. The scrotum is small, red, and empty, the testicles being still within the abdominal cavity. The labia project, but do not conceal the clitoris which projects between them; they are slightly developed. The membrana pupillaris is still present and distinct. The nails are readily recognized. The bladder is pyriform in outline and hard, with a small cavity. The length of the fœtus is about twelve inches, and the weight one pound or a trifle over.

At the end of the *twenty-eighth week* (seventh month) the fœtus is from fourteen and a quarter to fifteen and a quarter inches in length, and weighs from two to four pounds. The skin is of a dirty red color, and the hair on the head about half an inch long. The testicles begin to descend. The cerebral convolutions begin to form. The ears are in close apposition to the head, and the membrana pupillaris shows signs of disappearance. An ossific centre can be detected in the os calcis toward the second half of the twenty-fourth week. There is no longer any adherence of the eyelids, and the nails are much firmer in consistence. The diameter of the great fontanelle is about one and three-fifths inches, while all of the other fontanelles are readily observed. The skin is covered with lanugo and vernix caseosa. Should birth of the child take place at this period, the arms and

[1] From this time onward an approximate basis for the estimation of the age of the fœtus is formed on its length.

legs would be flexed in precisely the position they assumed within the uterus.

At the end of the *thirty-second week* (eighth month) the weight of the fœtus is from three to four pounds, while its length is from fifteen to sixteen inches. Ossification begins in the last sacral vertebra. The nails almost reach the tips of the fingers. There is an ossification centre in the astragalus. The membrana pupillaris is absent. The testicles are either in the scrotum or the inguinal canal. The clitoris still projects between the labia, keeping them well apart. The skin is of a lighter color, thicker and more natural. It is covered with very fine, soft hair. The head hair is of a darker hue. The breasts often project at this period. The lungs are reddish in color, and the liver still of great size. This is an important month of utero-gestation, forensically, on account of the beginning of viability at the two hundred and tenth day.

At the *thirty-sixth week* (ninth month) the length of the fœtus is from eighteen to twenty inches, its weight averaging seven pounds. Ossification is more complete, and the bones of the head are in closer apposition, as the fontanelles are smaller. The hair on the head is darker and much longer, while the nails are of a more solid consistence, being prolonged to the tips of the fingers. The convolutions of the brain are more numerous, and the lungs of a redder color and more voluminous. The meconium almost fills the entire intestine. Urine is contained in the bladder. The testes have descended, and the vulvar orifice is occluded.

The *fortieth week* completes the intrauterine life of the child, as it is at this period fully developed.

The *point of insertion of the umbilical cord* when the fœtus has reached its full term will be of assistance in ascertaining the age. As a rule, the cord is inserted a few lines inferior to the middle of the body, while at an earlier period it is inserted at the centre. Out of five hundred cases of full-term pregnancies at the Maternité, Paris, observed by Moreau, only four showed the position of the umbilicus to be exactly in the centre of the body, the remaining number showing it to be from eight to ten lines away,—that is, below the centre of the body. Another test of the age of the fœtus at full term is that referred to by Béclard and others. It refers to the ossific deposit in the inferior epiphysis of the femoral bone. If this deposit is found wanting, the fœtus is not more than eight months of age; if it appears about the size of half a line, it is probably in the ninth month; and if it is from two to three lines in diameter, it has reached the full term. If an examination reveals the fact that the osseous deposit measures more than three lines across, the child has very likely been alive subsequent to its birth. (Reese.)

The size, weight, and development of children at maturity often vary considerably. The average weight is between six and seven pounds, although, as Cameron states, "a mature child may weigh as low as one pound or as high as twenty-eight and three-quarters pounds. . . . The gener

development is a safer guide than weight or measurement, and it is better to affirm maturity only when the majority of the appearances found in mature children are present."

At what Stage of Pregnancy has the Abortion occurred? This is determined from an estimation of the length and breadth of the pregnant uterus, and also from the development of the fœtus when it is possible to examine it. The uterus in the virgin is about three inches in length, two in breadth at the level of the Fallopian tubes, and one inch in thickness. The weight varies from one to one and a half ounces. The uterus at the termination of pregnancy weighs about thirty-five ounces. The size of the pregnant uterus during the various stages of gestation is as follows: at the third month it is five inches long and four inches wide; at the fourth month it is six inches long and five wide; at the fifth month, seven inches long and six wide; at six months, eight and a half long and six and a half wide; at seven months, ten long and seven wide; at eight months, eleven and a half long and eight wide; at nine months, thirteen long and nine wide; and at ten months it is fourteen inches in length and ten inches in width. After the contents of the pregnant uterus have been expelled, the various measurements just cited are somewhat diminished, a fact of importance to recollect when estimating the stage at which miscarriage has taken place.

Sequelæ of Abortion.—The *hemorrhage*, which is one of the most serious of the after-results of abortion, is occasioned by the rupture of the vascular connections between the uterus and ovum. Its gravity depends upon the rapidity and thoroughness with which the contents of the uterus are evacuated; for if the latter be emptied completely within a few hours, the bleeding is arrested. This is brought about by the complete occlusion of the mouths of the blood-vessels from which the hemorrhage issues. If, on the other hand, the entire contents of the uterine cavity have not been expelled by the contractions of the organ, the hemorrhage may assume an alarming aspect, and by reason of its abundance prove rapidly fatal. The medical examiner should, therefore, be very careful in giving an opinion, unless he be cognizant of the exact condition of the patient, the time of the pregnancy, and the quantity of blood that may have escaped.

Septicæmia is produced by pus-forming micro-organisms or putrefactive germs entering the blood, thereby begetting a low or typhoid form of fever, which speedily destroys the patient. This condition follows as a consequence of criminal rather than of natural abortion or of that artificially produced by the obstetric surgeon. As has already been pointed out, the modern method of inducing abortion (criminal) is undertaken only with the best antiseptic precautions; so that really there is no more danger to the subject upon whom the operation is to be performed than in any other surgical work of equal gravity. The real danger lies in those cases which are brought under the supervision of ignorant, unskilled, uncleanly, and careless operators, who are generally surrounded by unsanitary conditions. Patients subjected to such treatment are liable to septicæmia,

for just such conditions favor the entrance into their systems of pyogenic germs. Septicæmia may, however, occur in those cases of natural abortion in which the vitality of the patient is weak. Again, it may follow the miscarriage if the woman's person or surroundings be unclean; and furthermore, infection may result from artificially induced abortion undertaken with antiseptic precautions, if the operator be unskilled or employs considerable violence in bringing about the desired result, or if the loss of blood be excessive.

Cameron[1] says, "While the occurrence of septicæmia after an abortion may excite suspicions as to the use of instruments or criminal interference of some kind, it affords no reliable evidence one way or the other. . . . The teachings of modern antiseptic surgery should be borne in mind when estimating the after-consequences of criminal abortion." In a foot-note (p. 130), the same writer states that "sepsis is highly suspicious, but not conclusive of interference. It has been estimated that a fatal result occurs in seventy-nine per cent. of cases of criminal abortion. Out of ninety-six cases of criminal abortion, seventy-six ended fatally; while of twenty-six cases of abortion carefully induced with antiseptic precautions, none died."

Among other sequelæ of abortion is *subinvolution*, with its consequent flexions, versions, and displacements. Menorrhagia, leucorrhœa, and other affections are also liable to attend this condition of the uterus. Tetanus[2] is of rare occurrence.

The *consequences* of abortion induced by the *administration of drugs* are frequently of the most serious nature. Thus, after irritant poisons have been used for their abortive effects, the miscarriage occurs only as a consequence of the grave constitutional disturbances which they incite; and if the patient gets well, she is apt to suffer for a great length of time from gastro-intestinal disorders. Other symptoms that are liable to follow the use of abortifacient drugs are debility, nervous prostration, indigestion, nausea, vomiting, diarrhœa, constipation, hemorrhoids, excessive irritability of the bladder, etc. There may also be symptoms of pelvic hyperæmia and menstrual disturbance. These are some of the most common effects of the use of abortifacients.

The *lesions* that the medical examiner may find in criminal cases of abortion will always depend, as to their nature, upon the variety of the means resorted to in bringing about the result, and, further, the amount of force used when employing them. Tears and cuts generally result from the use of such instruments as scissors, knives, etc.; while punctured wounds, which are sometimes very difficult to discover, are usually occasioned by sharp-pointed bodies like sounds, knitting-needles, umbrella-ribs, etc. More or less bruising accompanies all attempts at abortion, especially where large

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[1] Op. cit.

[2] *Vide* Tetanus, by Justin Herold, A.M., M.D. American Medico-Surgical Bulletin, August 1, 1895.

rough instruments have been employed, such as scissors, etc. In sor stances the fœtus may be injured ; while, on the other hand, there may such injury apparent. The bladder has been perforated and the uter suffered similar injury at the hands of an ignorant operator. Cam mentions the case of a young woman of twenty years, who, while i fourth month of pregnancy, submitted to a criminal operation. The frightful injuries resulted. The instrument used was a hard gum- catheter. During its manipulation by the operator it perforated the f of the uterus and made its way up under the liver. Portions of the ce wall were scraped away for placental tissue, and by means of ovum for loop of intestine was dragged down, being mistaken for the cord. Th torn away.

"The expert must not only determine the site, extent, and pr origin of the traumatisms," says Dr. Cameron, "but must trace the or inflammatory processes to them, excluding other causes. . . . V traumatisms are found, the important question to determine is whethe occurred spontaneously or were produced artificially. Perforating w of the uterus do not occur spontaneously ; penetrating rupture of the is very rare, generally occurring at or near full term, the uterine walls weakened near the point of rupture by disease, cicatrices, or fibro Healthy uterine tissue does not tear spontaneously, and unhealthy cond can be made out by careful microscopic examination of the tissue ne site of the tear. Is it thin or cicatrized, is a fibroid situated near by, o the placenta attached thereabouts? The size, shape, and appearance s be noted. In the first six months spontaneous rupture is still rarer, alth it has occurred in the fourth, third, or even second month. Rupture o uterus may occur in the early months in the rudimentary horn of a d uterus. Ruptures of the uterus apart from labor have been doubted, ye debrandt has published one case. Piltz describes a rare case of sponta rupture of the fundus during labor. A rare case of spontaneous ruptu the uterus in the cicatrix of a previous rupture was reported recently, a diagram, in the *Archiv für Gynakologie*. Remarkable cases of rec after rupture of the uterus have been reported."

A fact of considerable importance in connection with the kind of i ment used in producing a wound is that uterine contraction or subse necrosis may so enlarge a minute wound or puncture as entirely to the examiner off his guard ; hence the necessity of recollecting this when making such examinations.

The employment of *vaginal douches*, or the injection of fluid betwe membranes and the wall of the uterus, may be followed by periton metritis. Again, immediate fatal results have followed the entrance or fluid into the uterine sinuses. Acute peritonitis has resulted fro passage of air or fluid along the Fallopian tubes into the abdominal c

[1] Op. cit.

(Cameron.) Rupture of the uterine wall has occurred as a result of the forcible injection of fluid into the cavity of the organ.

Duties of the Medical Examiner in Cases of Criminal Abortion.—In a case of criminal abortion the physician is frequently placed in a most trying position. He should ascertain, if possible, the means employed in bringing about the result; and for this purpose a thorough examination of the vagina and uterus should be made to note whether the marks of instruments are apparent. The stomach and intestines should also be inspected for signs of irritant poisons, such as abortive drugs usually are. (*Vide* subsequent paragraphs.)

(1) *Is it the duty of a physician to inform the officers of the law that an abortion or miscarriage has been produced or attempted illegally?* (2) *Does he render himself a particeps criminis under the law if this information is not forthcoming?* The following circular letter addressed to the Chairman of the Board of Censors of the Medical Society of the County of New York by Robert C. Taylor, Esq. (counsel), will be of interest in reply to the above questions:

"NEW YORK CITY, April 22, 1895.

"*To the Chairman of the Board of Censors of the Medical Society of the County of New York:*

"DEAR SIR,—The Medical Society of the County of New York has requested me, as their counsel, to advise them what is the status of a physician who has been called in to attend a case where a miscarriage or abortion has been brought about, in order that the rights of a professional man in such a delicate predicament may be more distinctly understood, and he be able to render the offices of humanity freely, without fear of himself being suspected as accessory to a crime.

"It may be said by way of preface that there is no definite or positive rule by which a physician may be guided in such a case; and the question, therefore, becomes one rather of general good sense and prudence. It is assumed that the physician is brought face to face with a state of facts in which he has reason to fear that a criminal operation has been performed, and yet cannot possibly so conclude. It is the design of this paper briefly to indicate the various considerations of law which have any bearing upon his conduct in such a predicament.

"At common law (independently of the New York statute) there was a certain crime known as misprision, which consisted in the failure of an individual to report to the proper authorities any crime which he had reason to suspect. This failure on his part was in itself a misdemeanor.

"In the State of New York, however, the common law has been superseded by the Penal Code; and what is not declared by that code to be a crime is no crime to us. Mere misprision, as such, is not made a crime here.

"It is, of course, a moral duty for every individual to assist as far as he can in the detection of crime and the bringing of the guilty to punishm

but we are not now and here concerned with mere moral duties of imp obligation.

"There are many laws requiring reports to Boards of Health of tagious diseases, births, deaths, and the like.

"As to the duty of reporting matters to the coroner, we find no s of general application throughout the State, but note the following se of the Consolidation Act affecting New York City:

"'SECTION 1773.—*When in the City of New York any person die from criminal violence, or by a casualty, or suddenly when in app health, or when unattended by a physician, or in prison, or in any susp or unusual manner, the coroner shall subpœna one of the coroner's physi who shall view the body of such deceased person, externally, or ma autopsy thereon as may be required.*

"'SECTION 1775.—*It shall be the duty of any citizen who may b aware of the death of a person who shall have died in the manner sta the last section but one, to report such death forthwith to one of the cor or to any police officer, and such officer shall, without delay, notify the ner of such death; and any person who shall wilfully neglect or ref report such death to the coroner shall, upon conviction, be adjudged gui a misdemeanor, and shall be punished by imprisonment in the county p not exceeding one year, or by a fine not exceeding five hundred dollars, such fine and imprisonment.*'

"It would thus seem that, by the very wording of the statute, could be no crime in the mere failure to report any suspicious case did not result in *death*.

"It therefore follows that the physician's duty to report a case ness which he suspects to involve criminal malpractice is not a duty imp upon him by any statute, and that for his failure so to report, consider itself alone and apart, he is not liable to any specific punishment.

"Theoretically speaking, the position of the physician is impreg and his immunity complete. From a practical stand-point, however, patient die and the circumstances be such as to lead any one to believe malpractice has been committed, he runs a grave risk of suspicion of accessory.

"His duty under the circumstances, then, relates only to himself, an conduct should be such as to conduce to his own protection.

"If he receives a call to attend an urgent case he cannot decline it, though it be suspicious.

"Where the patient is in the house of a midwife, or where there slightest reason to believe that a criminal act has been committed o death might ensue, it is his imperative duty to provide himself with th vices of a consultant, whose evidence, added to his own, should suff prove the integrity and wisdom of the treatment.

"If the patient is transferred to another professional man or to a hos prudence would further dictate that the physician and the consultant car

their successor the details of the treatment and also communicate vant circumstances, whether they be suspicious or not.

ch a transfer of the patient could be made to impose upon the trans- entire burden and responsibility.

the physician has reason to believe that a criminal act has been d, he should communicate his suspicion to the coroner, and thus 1 that official the duty of ferreting out what crime, if any, has been ed.

all that he does he should be open and above-board, so that sus- any arise, may be disarmed. This is, after all, all the advice that iven.

t be suggested that the physician is by law incompetent to divulge on professionally acquired, a sufficient answer is found in the words atute creating the incapacity :

person duly authorized to practise physic or surgery shall not be o disclose any information which he acquired in attending a patient essional capacity, and which was necessary to enable him to act in city.' [1]

nost embarrassing mass of adjudication has been the result of the construe this enactment, and its true meaning is much in doubt. A , however, to the words 'necessary to enable him to act' will discover ormation the physician is incompetent to divulge. Each physician ermine this question largely upon his own responsibility. To the mind it would seem that it was of no moment to the physician the act which was responsible for the patient's condition had been or innocent. The steps which he must take to relieve the patient the same in either alternative. If this be so, the knowledge thus would not, in itself, be 'necessary to enable him to act,' and hence t come within the protection of the statute.

clear duty to protect himself by making the disclosure would not, , be complicated by any supposed duty of silence existing toward nt.

far as the risk of being held liable for slanderous or libellous state- concerned, it is enough to say that a physician who, in good faith, on to believe that the crime of procuring an abortion had been com- vould be protected from any action for damages, if he communicated cions to the proper authorities, even if it afterwards turned out that on against whom he had given information was not guilty of the 1 crime.

ch communications are known to the law as Privileged Communi- and the privilege arises from the fact that it is the duty of every o do whatever he can to assist in the detection and punishment of

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[1] Code Civ. Proc., Sec. 834.

"It should be observed that such communications must be sensibly made. They must be honestly believed, and the communication must be limited to those who have jurisdiction to entertain the complaint, or power to redress the grievance, or some duty or interest in connection with the matter. If the physician idly disseminated his suspicions, and they turned out to be false, he would then plainly and justly be liable to the individual whom he had carelessly slandered.

"By Section 773 of the Penal Code the coroner is expressly authorized to act when he 'is informed that a person has been dangerously wounded by another.' This shows, by plain analogy, that he is authorized to receive communications, which, if made in good faith, would be clearly privileged.

"Nevertheless, if, after all precautions, a physician should be arrested upon suspicion of being accessory to an act of criminal malpractice, his remedy, if he is innocent, is to prosecute those who caused his arrest. The causes of action which the law gives for false imprisonment and malicious prosecution are supposed to be adequate to redress such injuries. As against the newspapers, if he had been in fact arrested, and they published true, though annoying, accounts of the matter, he would have no remedy; but this is an unfortunate case, for which it is impossible to provide.

"Although the position of a physician in a predicament such as the one that these pages assume is not agreeable, yet it would seem that the incidental risk cannot well be avoided. It is of the highest importance to the public safety that the public authorities should have utmost freedom to inquire into all cases of suspected crime; and any change of the existing provisions of law, though it might add to the security of an individual physician in an individual instance, might, on the other hand, seriously interfere with the protection of public interests of vastly greater importance.

"Respectfully submitted.

"ROBERT C. TAYLOR,

"*Counsel.*"

Signs afforded by the Mother.—For the purpose of obtaining accurate evidence, the examination, *during life*, should be made as soon as possible; otherwise the results will be negative or of no material value. The value of medical evidence also depends upon the time that has elapsed since the uterine contents were expelled. The signs afforded during the early months of gestation are less marked than they would be were the period later; and it is, therefore, impossible to lay down any general rule for the guidance of those interested in the examination. Cameron[1] says, "In some cases abortion cannot be affirmed positively after twenty-four hours; in others it may be demonstrable after several weeks."

The *signs of abortion in the living* may be stated as follows: a genera

[1] Op. cit.

laxed condition of the vulva and genital passages; patulousness of the s and cervix uteri, with or without fissures, tears, etc.; the existence of chia during the early stages and a whitish or yellowish discharge at a later eriod; and, further, the enlarged breasts with their color-changes, the resence of colostrum, and the characteristic acid smell common to women n this state are valuable signs. In some cases the general appearance of he pregnant woman will indicate anæmia. Another sign almost invariably present is a peculiar excitement of the pulse with dryness of the skin. If here be lacerations of the os uteri, or other traumatisms, they may be made out, as a rule, by the examining finger, although it may be necessary in some nstances to make use of the speculum. To determine the size of the uterus, examination is carried on by the bimanual plan. Further, note should be made of all signs of violence to the vagina or uterus, and whether there be an excessive inflammatory condition of the genital apparatus.

The relaxed condition of the vagina and the expulsion of blood from the genital tract might readily be referred to menstruation, and the somewhat enlarged state of the os uteri might merely indicate some disease of that organ; hence it is that a female may with more ease conceal her pregnancy during the early months of utero-gestation. (*Vide* Delivery.)

Of the constitutional symptoms of abortion, which are dependent upon the period of gestation, the amount of violence inflicted, etc., rise in temperature and quickened pulse may be absent. In some instances there are no constitutional disturbances.

The medical examiner, besides making a minute examination of the breasts and genital organs, should also direct his attention to the body for signs or marks of violence.

After death, if putrefaction has not advanced too far, the results obtained are, as a rule, of greater definiteness than those elicited *ante mortem;* hence the case may usually be made out satisfactorily. This applies to those cases where death has occurred within three or four days of the attempt to induce an abortion. If, on the other hand, three or four weeks elapse before the death of the woman, the difficulties are vastly increased, and it becomes next to impossible to determine by the autopsy any signs of abortion, a fact especially true if the miscarriage took place in the early stage of utero-gestation.

The medical examiner should examine minutely the different viscera, and also the genital tract. Care should be taken not to injure the parts by the knife or otherwise during the autopsy, lest the injury inflicted by the examiner be mistaken for traumatisms connected with the abortion. The marks of injury produced by the use of instruments in inducing abortion are generally found in the vagina and uterus; they are, as a rule, occasioned by inexperienced hands. Perforations of the cervix and fundus uteri indicate the use of pointed instruments. These latter may also be lacerated (more or less) and irregular in contour. They are generally multiple, and are frequently accompanied by a loss of substance. In other cases

blunt instruments, like a male catheter, are employed. Admitting the use of these means of procuring abortion, the existence of marks of metritis and peritonitis is often readily perceived. In a case cited by Reese,[1] the instrument, which was a blunt one, passed up between the membranes and the walls of the uterus and tore the placenta, causing an internal hemorrhage which ended in the death of the woman.

In a case where the patient has lived for some time after the performance of the operation, evidences of repair will be shown. Another point of importance for the medical examiner to note is whether there is any indication in the viscera of general anæmia due to sudden loss of blood. In women who die during a menstrual period, congestion of the uterus and pelvic viscera will very likely exist, together with a thickened state of the organ and a swollen condition of its mucous lining. These appearances must not be confounded with those due to abortion.

As already pointed out, evidences of irritant poisoning by abortifacient drugs should be looked for in the visceral organs and in the urine.

Examination of Substances expelled from the Uterus.[2]—If a fœtus be found, a very careful and minute examination should be instituted to determine its probable age, maturity, and viability; whether it was born living, and, if so, what caused its death. The recognition of injuries or wounds will suggest the query as to their being *ante* or *post mortem* in origin. Tidy, relative to this latter point, says it "is essential, not so much to prove that the wound was sufficient to cause death, as to negative the certain contention on the part of the defence that the injury was caused after birth." If any portion of the amnion, chorion, decidua, or placenta be found, the proof of abortion will be assured; but as the recognition of these diagnostic tissues is not always easy, no definite conclusion should be reached until all doubts have been removed by the use of the microscope. The absence of any of the fœtal structures mentioned does not, however, negative the occurrence of abortion.

Evidence of abortion is often afforded by the presence of stains upon the bedding, clothing, etc.; therefore an examination (microscopic if necessary) should be made of these articles.

Examination of Instruments, Drugs, etc., in Possession of the Suspected Individual.—All instruments should be subjected to a careful inspection for stains of blood, hairs, parts of fœtal membranes, etc. They should also be compared with any wounds which may be discovered upon the body. The importance of inspecting drugs resolves itself into determining their identity and activity. "Liman records a case where a decoc-

[1] Op. cit.

[2] The legal physician should not overlook the fact that signs of abortion may follow the expulsion of hydatids and moles. Another point of interest to remember, in connection with the subject of abortion, is that a corpus luteum may be discovered in the virgin state.

on of savine had been taken as an abortifacient. He found it dried up and dorless when rubbed; he testified that the sample submitted to him was nert as an abortive, having lost its active principle entirely."[1]

With further regard to stains, those due to meconium (a dark-greenish viscid fluid) are frequently recognizable. This substance produces the bile reaction with the nitric acid test, and occasions a greenish tint with iodine. Under the microscope, intestinal epithelium and crystals of cholesterin are observable. The blood that is discharged during an abortion presents no characteristic appearances differing from that derived from any other source. (*Vide* Blood.) Late abortions may account for the presence of vernix caseosa on the woman's linen or bedclothing.

Tabular Statement for Reference.—The following tabular statement is from Tidy's "Legal Medicine," vol. iii. p. 109.

I. *Examination of the Mother, if Living.*

(1) Temperature.

(2) As to the woman's predisposition to abort, and the period at which abortion had commonly occurred.

(3) General state of health. (Note existence of leucorrhœa, excessive menstruations, syphilis, asthma, malignant diseases, etc.)

(4) Whether the woman be well-formed or ill-formed. (Note pelvic malformations, effects of tight lacing, etc.)

(5) Whether or not there be signs of recent delivery, or of the expulsion of uterine contents.

(6) Whether any cause can be assigned for the abortion,—*e.g.*, violent coughing, bloodletting, straining at stool, violent exercise, undue excitement, septic poisoning, violence, administration of medicines, etc.

(7) All injuries of the genital organs. (Consider whether the injuries might be self-inflicted.)

II. *Examination of the Body of the Mother, if Dead.*

Note.—(1) The necessity for care not to mistake the effects of menstruation for those produced by abortion.

(2) To avoid injuring the parts by the knife or otherwise during the autopsy.

(3) To consider the possibility of injuries being self-inflicted.

(*a*) Note the existence of any marks of violence on the abdomen or other parts.

(*b*) The condition of the genital organs, noting all inflammations, rents, tears, perforations, etc. (If the uterus be injured, it should be preserved.)

Note also.—(1) The condition of the passage (relaxed or otherwise).

(2) The condition of the os uteri (virginal or gaping, etc.).

(3) Vaginal secretions, and, if present, their character.

(4) The general appearance of the breasts, presence of milk, etc.

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. ii. p. 140.

(*c*) Whether there be any signs of irritant poisoning in the stomach, or of inflammation of the bladder, kidneys, rectum, etc. (The contents of the stomach, if necessary, to be preserved.)

(*d*) Whether the viscera generally indicate loss of blood during life.

III. Examination of the Product of Conception.

(1) Nature of the supposed product of conception.

(2) Consider whether there is evidence of a diseased condition of the membranes of the placenta,—*e.g.*, structural degeneration.

(3) If a fœtus be found, determine (1) whether it was born alive, (2) its probable age, and (3) the cause of its death.

(4) Determine whether, if there be wounds or other injuries, they were inflicted during life or after death.

IV. Examination of all Drugs, Instruments, etc.

Medico-Legal Bearings.—"*At Common Law.*—If the mother gives her consent to the act, and quickening has not occurred, there is no crime by the common law; nor is the inducing of an abortion a felony, if the product of conception has quickened.[1] When, in consequence of the means employed to procure an abortion, the death of the woman follows, then it is murder at common law; but by statute in some States it is made manslaughter.[2]

"*Intention.*—By the administering of any drug, noxious thing, or other matter or substance, or the employment of any instrument calculated to induce abortion, whether the object be attained or not; if abortion be the intention, the crime is complete. The drug given may even be perfectly harmless. The administration of a drug, or the actual use of an instrument, is not necessary to the incrimination; if any person sells or supplies any drug, or thing to be taken, or any instrument to be used, knowing that miscarriage is the intention, he is an accessory. It is immaterial whether or not the woman was pregnant, although a miscarriage can be effected at any time after actual conception. A woman is quick with child from the period of

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[1] "After a patient investigation we are forced to the conclusion that it never was a punishable offence at common law to produce, with the consent of the mother, an abortion prior to the time when the mother became quick with child. It was not even murder at common law to take the life of the child at any period of gestation, even in the very act of delivery." Hines, J. Mitchell *vs.* Com., 78 Ky. 204; s. c., 39 Am. Rep. 227. See Com. *vs.* Bangs, 9 Mass. 387; Com. *vs.* Parker, 9 Metc. (Mass.) 263; s. c., 43 Am. Dec. 396; Smith *vs.* State, 33 Me. 48; State *vs.* Cooper, 22 N. J. L. 52; s. c., 51 Am. Dec. 248; State *vs.* Slagle, 82 N. Car. 653; People *vs.* Sessions, 26 N. W. Repr. (Mich.) 291; Ann. *vs.* State, II. Humph. (Tenn.) 159; Abrams *vs.* State, 3 Iowa, 274; s. c., 66 Am. Dec. 77; Hatfield *vs.* Gano, 15 Iowa, 178. The *contra* view seems to have been followed by the Pennsylvania Supreme Court. Mills *vs.* Com., 13 Pa. St. 633; Com. *vs.* Demain, 6 Pa. Law Jour. 29; s. c., Brightly, 441.

[2] 4 Black Com. 201; 1 Bishop Cr. L. 328; State *vs.* Moore, 25 Iowa, 128; State *vs.* Dickinson, 41 Wis. 299.

nception and the commencement of gestation, but is only pregnant with quick child when the child has become quickened in the womb.

"If a person intending to procure an abortion does an act which causes child to be born so much earlier than the natural time that it is born in a ate much less capable of living, and afterwards dies in consequence of its xposure to the external world, the person who, by this misconduct, so rings the child into the world, and puts it thereby in a situation in which cannot live, is guilty of murder, and the mere existence of a possibility hat something might have been done to prevent the death will not render it ss a felony.[1] The *evidence* of the woman upon whom the abortion was

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[1] *Intention.*—"State *vs.* Owens, 22 Minn. 238; Wilson *vs.* State, 2 Ohio Stat. 9; State *vs.* Gedicke, 43 N. J. L. 86; State *vs.* Fitzgerald, 49 Iowa, 260; s. c., 31 n. Rep. 148; State *vs.* Murphy, 3 Dutch. (N. J.) 112; R. *vs.* Hillman, 9 Cox Cr. s. 386. If the drug is taken in the absence of the giver, he 'causes it to be taken.' *vs.* Wilson, Dearsly & B. 127; People *vs.* Josselyn, 39 Cal. 396; Stephen's Dig. Cr. (Am. ed.) 176, *note*. Even if the intention exists only in his own mind. R. *vs.* llman, Leigh & C. 343; State *vs.* Stewart, 52 Iowa, 284. To constitute an adminering there need not be an actual delivery by the hand of the prisoner. R. *vs.* rley, 4 C. & P. 370. It was proved that the woman requested the prisoner to get r something to procure miscarriage, and that a drug was both given by the prisoner d taken by the woman with that intent, but that the taking was not in the presence the prisoner. It was *held*, nevertheless, that the prisoner had caused the drug to taken within the meaning of the statute. R. *vs.* Wilson, Dears. & B. C. C. 127; *vs.* Farrow, Id. 164, acc. See R. *vs.* Fretwell, 31 L. J., M. C. 145. Mere belief of e existence of pregnancy is sufficient to justify the inference of intent. Powe *vs.* ate. 48 N. J. L. 34. A husband assaulted and beat his wife, then about three months egnant. Shortly after such beating she miscarried. It was not proved that the husnd desired or intended such a result: *Held*, that a conviction for abortion could not sustained. Slattery *vs.* People, 76 Ill. 217. Where drugs were administered, and instrument thrust into the body of the deceased, with specific intent to produce an ortion, these acts imply malice aforethought. State *vs.* Thurman, 66 Iowa, 693; tate *vs.* Owens, 22 Minn. 238; State *vs.* Gedicke, 43 N. J. L. 86, where defendant preribed 'Dr. Clark's Female Periodical Pills;' R. *vs.* Hollis, 12 Cox Cr. Cas. 463; R. Hennah, 13 Cox C. C. 548. *Noxious Thing.*—A small quantity of savine, which as sufficient only to produce a little disturbance of the stomach, *held* not a noxious ing. R. *vs.* Perry, 2 Cox Cr. Cas. 223. This case doubted and criticised, Storer & I. Abor. 196. If the drug is liable to cause injury to a pregnant woman, it is noxious. ougherty *vs.* People, 1 Colo. 517. Upon an indictment for administering *savine*, the harge was that the prisoner administered 'six ounces of the *decoction* of a certain hrub called *savine* then and there, being a noxious and destructive thing.' It apeared that the prisoner had prepared the medicine by pouring boiling water on the aves of the shrub, and the medical men examined stated that such preparation is alled an *infusion* and not a decoction. It was objected that the medicine was misescribed. The objection was overruled. The court said *infusion* and decoction are *iusdem generis*, and the variance is immaterial. The question is whether the prisoner dministered *any matter or thing* to the woman with intent to procure abortion. R. *s.* Phillips, 3 Campb. 78. The authority of this decision appears to have been recogized in the following case. The prisoner was indicted for administering saffron to e prosecutrix with intent to procure abortion. The counsel for the prisoner cross-

produced is admissible, but not her dying declarations, unless homicide is

examining as to the innocuous nature of the article administered, Vaughan, B., said, 'Does that signify? It is with the intention that the jury have to do; and if the prisoner administered a bit of bread merely with the intent to procure abortion, it is sufficient to constitute the offence contemplated by the act of Parliament.' R. *vs.* Coe, 6 C. & P. 403. The words in the clause of the statute under which the prisoner appears to have been indicted in this case were 'any medicine or other thing.' Where the prisoner was indicted for supplying a 'certain noxious thing,' and the evidence was that the thing supplied was of a perfectly harmless character in itself, though if taken with the belief that it will procure a miscarriage, it might, by acting on the imagination, produce that effect, it was *held* that the conviction must be quashed, as there was no evidence that the thing supplied was noxious. R. *vs.* Isaacs, I. L. & C. 220; 32 L. J., M. C. 52. But where there was no evidence of the ingredients of the thing administered, or of its character being harmless or otherwise, except that in fact it made the witness ill and produced miscarriage, it was *held* that there was evidence of its being a noxious thing. R. *vs.* Hollis, 12 Cox C. C. R. 463. If the drug be innocuous if taken in small quantities, but harmful if taken in large, it would appear to be a noxious thing. R. *vs.* Cramp, 5 Q. B. D. 307; R. *vs.* Hennah, 13 Cox, 547. *Accessories.*—Com. *vs.* W——, 3 Pittsb. (Pa.) 463, where defendant advised excessive exercise. Evidence is admissible to show that the accused received the woman upon whom the abortion was committed to board, knowing her condition, for the purpose of having an abortion performed upon her, and that he had procured a physician to operate upon her. Com. *vs.* Adams, 127 Mass. 15. In People *vs.* Vedder, 98 N. Y. 630; s. c., 34 Hun (N. Y.), 280, it was *held* that a woman permitting an abortion is not an accomplice under the Penal Code, § 294. To the same effect Com. *vs.* Boynton, 116 Mass. 343; Dunn *vs.* People, 29 N. Y. 523; Com. *vs.* Brown, 121 Mass. 69; Com. *vs.* Wood, 11 Gray (Mass.), 85; State *vs.* Owens, 22 Minn. 238; State *vs.* Hyer, 39 N. J. L. 598. Although the woman is not an accomplice, her moral implication may properly be considered in weighing her testimony. Watson *vs.* State, 9 Tex. App. 237. It is not a crime for her to take the potion. State *vs.* Hyer, 39 N. J. L. 598. *Compare* Solander *vs.* People, 2 Colo. 48. A father is accessory who consents to the attempt. Watson *vs.* State, 9 Tex. App. 237. The woman's evidence is competent against those mutually engaged with her in the act. Solander *vs.* People, 2 Colo. 48; People *vs.* Vedder, 98 N. Y. 630. *Consequence not Material.*—R. *vs.* Coe, 6 C. & P. 403; U. S. *vs.* Bott, 11 Blatchf. (U. S.) 346; Dougherty *vs.* People, 1 Colo. 514; State *vs.* Gedicke, 43 N. J. L. 86; Com. *vs.* Morrison, 16 Gray (Mass.), 224. The indictment need not allege what the drug was. Watson *vs.* State, 9 Tex. App. 237; Com. *vs.* Morrison, 16 Gray (Mass.), 224. Nor that it was noxious. Com. *vs.* Morrison, 16 Gray (Mass.), 224. The drug may be harmless. State *vs.* Fitzgerald, 49 Iowa, 260; s. c., 31 Am. Rep. 148. See State *vs.* Gedicke, 43 N. J. L. 86. *Pregnant—Quick with Child.*—R. *vs.* Goodchild, 1 Den. C. C. 187; s. c., 2 Car. & K. 293; Com. *vs.* Taylor, 132 Mass. 261; R. *vs.* Titley, 14 Cox Cr. C. 502. In Iowa it has been *held* that the pregnancy, as well as the administering of drugs or use of instruments, must be proved beyond a reasonable doubt. State *vs.* Stewart, 52 Iowa, 284. In New Jersey mere belief of the existence of pregnancy is sufficient, with other circumstances, to justify the inference of intent. Powe *vs.* State, 48 N. J. L. 34. In Vermont and Massachusetts it is *held* that it is immaterial whether the fœtus be alive or not. State *vs.* Howard, 22 Vt. 380; Com. *vs.* Wood, 11 Gray (Mass.), 85; Com. *vs.* Taylor, 132 Mass. 261; Smith *vs.* State, 33 Me. 48; s. c., 54 Am. Dec. 607. In Michigan the fœtus must have quickened. People *vs.* McDowell, 30 N. W. Repr. 70. In Pennsylvania it is *held* that the moment the womb is instinct with embryo life, and

ged.[1] The testimony of a physician who attended the woman subse-
nt to the procuring of the abortion is not admissible, but the evidence physician who made a *post-mortem* examination of the woman is com-
nt testimony. Evidence that instruments calculated to produce abortion found in the possession of the person charged is admissible. The in-
ments may be exhibited to the jury. It is competent to show that the
sed had previously used the same treatment on the same woman, and he had operated on others, but it is not competent to prove a similar

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ation has begun, the crime may be perpetrated. Mills *vs.* Com., 13 Pa. St. 631. iscarriage can be effected at any time after actual conception. Evans *vs.* People, . Y. 86; Wilson *vs.* State, 2 Ohio St. 319; State *vs.* Fitzgerald, 49 Iowa, 260; 31 Am. Rep. 148. *Death of Child.*—R. *vs.* West, 2 Cox Cr. Cas. 500; Wharton's . L. 942; Storer & H. on Abor. 154 *et seq.;* Com. *vs.* Brown, 14 Gray (Mass.), *Evidence.* . . . In Wisconsin and Indiana it has been *held* that dying decla-
ns are admissible. State *vs.* Dickinson, 41 Wis. 299; Montgomery *vs.* State, nd. 338; s. c., 41 Am. Rep. 815. . . . Evidence that the accused had an instru-
t in possession five months before the time of the alleged operation is admis-
. Com. *vs.* Blair, 126 Mass. 40. . . . At the trial of an indictment for unlawfully g a certain instrument, with intent to cause the miscarriage of a woman, evi-
ce that, in addition to using the instrument, the defendant also administered other wful treatment for the same purpose, and evidence that he used the same treat-
t on the same woman upon two other occasions than that named in the indict-
t, and but a few days previously thereto, is competent to show his intent and his wledge of the pregnant condition of the woman. Com. *vs.* Brown, 14 Gray ss.), 419. See Com. *vs.* Corkin, 136 Mass. 429. . . . Upon the trial of a party for rtion, evidence to prove a similar offence founded upon another and separate saction is not admissible, but in such case the prosecution will be put to its elec-
. Baker *vs.* People, 105 Ill. 453. Evidence that the accused had, before the nmission of the alleged abortion, told other persons that she had instruments erewith to produce abortion, and offered her services for that purpose at a certain ce, is admissible to show knowledge and intent, and the possession of necessary ans to accomplish the act in the chosen way of the accused. People *vs.* Sessions, N. W. Repr. (Mich.) 291."—*American and English Encyclopædia of Law*, vol. i.

[1] *Birdsey Stat. Abortion.*

4. Dying declarations evidence.

In all prosecutions under and in pursuance of this act, the dying declarations of woman whose death is produced by any of the means hereinbefore set forth shall admitted in evidence subject to the same restriction as in cases of homicide. L. 72, C. 181, § 6; and 1875, C. 352.

The balance of the 1872 law was repealed in 1886. This section was not.

Ante-mortem statement, if properly taken, is good evidence; the same as if the rson were alive and testified, subject to contradiction and impeachment, the same other testimony.

The ante-mortem statement must be properly taken. The person must be in-
rmed that she is dying. The following is the form:

"I, ..., having been subjected to an operation (or as case may be), and being in fear of death, do make this my dying declaration and tement, to wit..

"Subscribed and sworn to, etc., ..."

offence. Where a woman conspired with others to produce an abortion upon her, her acts and declarations in furtherance of the common purpose are evidence against the accessories. It may be shown that the drug administered was, in popular opinion, supposed to cause abortion. Evidence is admissible to show that the house of the accused, where the abortion was performed, was one of ill-fame, also advertisements tending to show that the accused was engaged in the business of procuring abortions. The health and spirits of the woman, also stains and marks upon her bedding, may be shown. The parts of the body of the dead woman, preserved in spirits, may be exhibited to the jury in connection with the testimony of the physician who made the *post-mortem* examination. The sexual intercourse between the woman and the accused, or between her and a third party, may be proved. (Com. *vs.* Wood, 11 Gray (Mass.), 85; Dunn *vs.* People, 29 N. Y. 523; People *vs.* McDowell, 30 N. W. Repr. (Mich.) 68.) The *corpus delicti* must be established. (In a prosecution for procuring an abortion resulting in the death of a pregnant woman, it is the procurement of miscarriage that constitutes the *corpus delicti*. Traylor *vs.* State, 101 Ind. 65.) The fact of the pregnancy, as well as the administration of the drugs, or the using of instruments, must be proved beyond a reasonable doubt. (State *vs.* Stewart, 52 Iowa, 284.) A physician testifying as an expert that he has discovered no traces of an abortion in a certain case may properly be asked whether such traces would exist under certain circumstances, even though no proof of such circumstances has been made. (Bathrick *vs.* Detroit, etc., Co., 50 Mich. 629."—*American and English Encyclopædia of Law*, vol. i., 1887, pp. 28–32.

Provisions of the Penal Code of the State of New York.[1]

"¶ 294. A person who, with intent thereby to procure the miscarriage of a woman, unless the same is necessary to preserve the life of the woman, or of the child of which she is pregnant, either,

"1. Prescribes, supplies, or administers to a woman, whether pregnant or not, or advises or causes a woman to take any medicine, drug, or substance; or,

"2. Uses, or causes to be used, any instrument or other means, is guilty of abortion, and is punishable by imprisonment in a State prison for not more than four years, or in a county jail for not more than one year.

"¶ 295. A pregnant woman, who takes any medicine, drug, or substance, or uses or submits to the use of any instrument or other means, with intent thereby to produce her own miscarriage, unless the same is necessary to preserve her life, or that of the child whereof she is pregnant, is punishable by imprisonment for not less than one year, nor more than four years.

"¶ 296. Any person who endeavors to conceal the birth of a child by

[1] These provisions are substantially the statutory provisions adopted by other States in the Union.

ny disposition of the dead body of the child, whether the child died before after birth, is guilty of a misdemeanor.

"¶ 297. A person who manufactures, gives, or sells an instrument, a dicine or drug, or any other substance, with intent that the same may be wfully used in procuring the miscarriage of a woman, is guilty of a ny."

n every case of abortion (criminal) the legal physician is confronted these leading medico-legal questions. (1) Has the fœtus in utero destroyed, and what are the evidences? or, in other words, Has the ion taken place? (2) If so, has this been occasioned by spontaneous tificial means? or, Was it caused by natural (including accidental) s, or by the intentional act of the pregnant woman herself or any individual? If artificial means were employed to induce abortion, he act justifiable or was it criminal? (3) Did the induced abortion the health of the woman or prove fatal? (4) Is the criminality of ion affected by the fact that the woman was not pregnant at all, by irth of monstrosities or of moles, or by the fact of an extra-uterine nancy? (The reader is referred to pages 442–445. *Vide* also Natural tion.)

n answer to the *fourth question*, we may state that the fact of non-nancy does not affect the criminality of abortion,[1] for the penalty of the npt is not excluded, notwithstanding the fact that an abortion is impos- to be effected in a woman not really pregnant. The same holds true regard to the birth of moles and monstrosities. The fact of an extra-ne pregnancy, likewise, does not invalidate such a charge.

)ther Legal Relations.—Cameron[2] says that "a legal point might arise whether a well-known habit of aborting might be alleged as a defence charge of criminal abortion. For example, some abortifacient drug (as t) may have been taken in moderate amount or in doses usually insuf- nt to produce abortion, nevertheless the woman aborts; would the lness of the dose be a good defence, if it can be proved that the woman in the habit of aborting easily? The medical witness should bear this in l, and ascertain the woman's previous history as to the ease, habit, or iency of abortion."

he same writer[3] says that "when the court asks an opinion as to the tive power of a drug, it is not needful to establish its specific action on uterus or its certainty as an abortifacient; it is sufficient to show its al liability to set up constitutional disturbances which are apt to termi- in abortion. If such a drug is given to a pregnant woman, but in too

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Cameron (op. cit., p. 101) refers to a case which was tried some time ago in ıgo. Metro-peritonitis was the cause of death, a midwife having been charged the attempt to procure abortion on the girl; but upon post-mortem examination made, the fact was revealed that the girl had never been pregnant, although she ved herself to be. An abortion had, however, been attempted.

Op. cit., p. 109. [3] Op. cit., p. 122.

small a dose to cause abortion, or if it fails because of the peculiar strength and resisting power of the woman, the charge still holds. But if a manifestly inert or unsuitable drug is employed, the charge would not hold, though there might be a point of law as to the intention.

"If abortion actually occurs, and a certain drug is known to have been taken previous to the abortion, was the abortion caused by the drug? In order to answer this question, it must be determined whether the symptoms were such as would have been caused by the drug, or whether they might have been referable to other or natural causes; whether, also, sufficient time elapsed between the taking of the drug and the abortion to establish a relation of cause and effect. As already remarked, these abortives act by producing severe constitutional disturbances, as the result of which abortion occurs; it is obvious, therefore, that it would be wrong to attribute abortion in any given case to the action of such a drug, unless there had been severe constitutional disturbance before the abortion took place. Most abortives are gastro-intestinal irritants or narcotics; we would, therefore, expect to find vomiting or narcosis occurring shortly after the administration of the drug, followed by more and more marked symptoms of poisoning as time goes on; finally, abortion occurs when the symptoms of poisoning are at their acme. It is important in such cases to save the vomited matters, if possible, for subsequent chemical and microscopic examination. Sometimes valuable information may be obtained from the chemical examination of the fœtal blood and tissues." (*Vide* Feigned Abortion.)

CHAPTER XXXV.

INFANTICIDE.

General Considerations—Definition—*Questions relating to the Infant*—Was the Child born Alive?—If so, how long did it survive?—Proofs that the Child has breathed—Viability—Was the Death due to Natural Causes or to Violence?—Was the Violence Accidental or Criminal?—Mode of conducting the Post-Mortem Examination, and the Evidence to be obtained therefrom—*Questions relating to the Mother in a Case of Infanticide*—The Signs of Delivery—The Signs furnished by the Early Examination of the Woman—Examination of the Milk—Concealed Delivery—Concealment of Birth—Feigned Delivery.

BY **infanticide** is understood the murder of a new-born infant. Under the English law it is not considered a specific crime, but is treated similarly to other cases of homicide. To justify a conviction of infanticide the child must be wholly born,—that is, its entire body must be brought alive into the world. The destruction of a partially born child cannot be regarded as murder. In a legal sense, it matters not whether the umbilical cord be intact or not, nor is the evidence of the child having breathed necessary to

rove that life existed at the time of its birth, since it is possible for an infant have respired and died previous to its birth. Furthermore, it is immaial, legally, whether the infant is killed immediately after its birth or a few urs or days subsequently, as the crime is subject to the same rules that are licable to other forms of homicide.

"The law humanely assumes that every child is born into the world dead, l the contrary is shown," observes Reese, "because so many children hus actually come into the world, and many others die very soon after various causes, and in these latter the signs of their having lived are uently indistinct. As the charge of infanticide can never be sustained ss there is distinct proof that the child was legally born alive, great diffi- is usually experienced in obtaining sufficient evidence to convict a an accused of this crime. As a general rule, she has been delivered in et, with no witness of the birth, and the body of the child is frequently ealed or destroyed. There is, besides, a general reluctance on the part jury to convict a woman of wilful murder for this crime, horrible as it is, ccount of a feeling of sympathy for the prisoner arising from the probay of her seduction and desertion."

The prevalence of the crime of child-murder throughout the world is great indeed. Previous to the establishment of Christianity the most lized nations legalized it. At the present day, although punishable by , its practice is none the less extensive, even among the most cultured of ple. The crime is, however, restricted to those children born outside of llock.

From what has been said it is evident that the duties imposed upon medical jurist are by no means of a slight nature, but rather are of the atest importance, as much depends upon the evidence he derives from an mination of the case.

In treating of the subject of infanticide, the following order will be foled: (1) the questions relating to the infant will be considered, and (2) e relating to the mother.

Was the child born alive? This question is of the greatest interest oth the medical and legal professions, on account of its criminal and bearings.[1] Where positive evidence from witnesses is wanting, the accurate solution to the above question must be derived from an intion of the general appearance of the child's body, from the condition he respiratory and circulatory systems, and from the condition of the ans within the abdominal cavity. Medico-legally, the term "born alive" lies the complete detachment of the whole body of a living child from of the mother; in other words, the complete delivery of a live infant the maternal passages.

In most instances of child-murder the birth generally occurred at full ; but in some cases children are born into the world before they have

[1] *Vide* Legitimacy; Inheritance.

reached the full period of intra-uterine development, either naturally or by artificial means, and it becomes of importance to the medical jurist to furnish an opinion, from an inspection of the body of the child, as to its probable age at the time of its birth.[1]

The *general appearance* of a child that has been *born alive* at full term and respired is something like the following description. The remains of the vernix caseosa are usually seen under the axilla and behind the ears. The eyes remain partly open, and cannot be permanently closed. The ears are not so close to the side of the head as is the case in children born dead. The hair is perfectly dry and clean, and the swelling at the back of the head (caput succedaneum) is more prominent than in the still-born. In the *dead-born* infant who has died immediately before its birth, the vernix caseosa will be found, more or less, over its entire body. The eyes are closed, and the ears are in close apposition to the head. The eyelids, when raised, close again. The mouth is closed, and from the nostrils is often observed exudations of watery blood. The hair is glued to the head. The thorax is unexpanded and flattened, and the lungs are situated at the posterior part of the thoracic cavity. They are greater in length than in breadth, and their margins are rounded. Upon pressure no crepitation is elicited. Within the trachea, which is flattened, may be found a viscid mucous secretion. The remnant of the umbilical cord appears fresher looking than that of a child that has survived its birth a few hours. (Reese.)

Maceration of the fœtus takes place if its death occurred some time previous to birth. This is, in fact, proof of death before birth, if discovered shortly after birth. If, however, sufficient time has elapsed for the process of *putrefaction* to become far advanced, no satisfactory conclusion can be drawn from the appearances. Uterine maceration is produced by the influence of the liquor amnii and the absence of atmospheric air. If the latter reaches the fœtus, putrefaction occurs.

In maceration the body will be found flaccid and flattened, and the epidermis covered with numerous vesicles, which form between the cutis and corium. These vesicles bear a striking resemblance to the skin-affection known as pemphigus. Their formation usually takes place two or three days after death. The cuticle may be more or less detached, especially about the abdomen. The head lies flat, no matter in what position it may be placed, and the bones thereof are freely movable one upon the other. The cellular tissue is infiltrated with sero-sanguinolent fluid, the blood-vessels being filled with dark blood. Occasionally disarticulation of the joints exists, and the cranial sutures are widely separated. Detached periosteum from the long bones is sometimes found. The cavities of the various visceral organs are filled with a large quantity of bloody serum. The lungs and the uterus are the only organs that remain unaffected by infiltration and friability for any

[1] *Vide* p. 449 to determine the probable age of an infant at birth.

th of time. The odor which is evolved from a macerated body is dis-eably sweetish. The umbilical cord is straight and flaccid.

Uterine putrefaction may take place while the fœtus is still alive, being to the decomposition of intra-uterine clots of blood. Putridity of the or amnii may be produced by the access of atmospheric air to the uterus sequent to the rupture of the membranes. This condition is not uncom-n, and is very often taken, together with physometra, as a sign of the de-position or death of the fœtus. According to Cameron,[1] "It would be y unsafe to affirm the intra-uterine death of a fœtus on the ground of the ridity of the liquor amnii, or the putrefactive changes in the sheath of cord, or the fœtal aspect of the placenta."

Mummification of the fœtus would be a positive sign of the death of the us some time before its birth, although it is a very rare condition. When, vever, it does follow, it is at about the time that the fœtus dies,—viz., the d or fourth month of utero-gestation. Mummification subsequent to h has occurred.

The most reliable proof of live birth is afforded by the *organs of respi-ion.* The fact of an infant having respired air and thereby lived is not a isive proof that it was born alive in the legal sense, as it may have athed anterior to its complete expulsion from the generative passages. thermore, a child may be completely born and alive some time before athing; and, again, the respiratory powers may be set in action before ulation, as where the breathing was inaugurated after birth, but previous he severing of the umbilical cord. Hence the importance of recollect- the fact that respiration is by no means the only evidence of the live h of a child. In fact, there is scarcely a single sign existing which can olutely establish or deny as to whether an infant was brought into the ld living or dead. Nevertheless, in cases where foul play is suspected, where the proofs of a living birth are to be found solely from an exami-on of the corpse of the child, the fact of respiration[2] is the principal of which is at all conclusive. If properly established it is invaluable.

A still-born child is one that is delivered completely from its mother hout having shown any sign of respiration. If, by proper attention and e, it survives and continues to live after the first respiratory effort, the n still-born ceases to be applicable.

Evidences of life before respiration cannot be detected by an inspection the dead body of a child; nor can any positive opinion be entertained m a mere examination of the lungs. If, however, injuries are discovered the child's body of such a nature as could not have been produced during th, and hemorrhage[3] accompanies them, the signs would be positive. rthermore, if proofs are deduced from eye-witnesses that the child's

[1] Op. cit. [2] *Vide* Legitimacy.

[3] The hemorrhage must be such as could have been occasioned only while the od was circulating.

breathing had been prevented, as by the mother herself, presumption of murder could readily be entertained. However, it is questionable whether a jury could be secured to convict such a person of the crime *minus* the evidences of life or respiration in the lungs. Relative to marks of violence found on a dead child, Taylor[1] says that those on the body of an infant that had perished twenty-four or more hours before birth would not possess the characteristics of injuries made on the living. Ecchymosis and effused blood coagula would be absent. "These marks," he observes, "when they exist, although they may establish that the child was either living or but recently dead at the time they were inflicted, can never show that the child was born alive. Injuries met with on the bodies of children alleged to have been born dead ought, however, to be of such a nature as to be readily explicable on the supposition of their having arisen from accident. If, from their nature, extent, or situation, they be such as to evince a wilful design to injure, it is a fair ground for a jury, not for a medical witness, to inquire why these extensive wounds, or other marks of violence, were inflicted on a child, if, as it is alleged, it was really born dead. It must be confessed that in such a case there would be a strong moral presumption of murder, although medical proof of life, or actually live birth, might totally fail."

1. *Proofs of a Live Birth afforded by the Respiratory Organs.*—The capacity of the *thoracic cavity* is considerably increased where the child has breathed, and the thorax has a vaulted appearance. The diaphragm is more depressed after breathing than before.[2] The *larynx*, after respiration, is considerably wider than it was before; it is not closed by the epiglottis. Before breathing it contains mucus.

The characters of the lungs before and after respiration are shown below in tabular form:

Lungs before Respiration.	*Lungs after Respiration.*
1. *Situation.*—Far back in the thoracic cavity, being almost hidden from view unless drawn forward. According to Schmidt, considerable volume may be attained, a phenomenon due either to artificial inflation or to the gases generated by decomposition.	1. *Situation.*—Almost fill the entire thoracic cavity. Their volume is greatly increased if the respirations are deep and continued; so much so that they cover, to a great extent, the heart and pericardium.
2. *Color.*—Is subject to variation. It is, however, usually of a bluish-red or deep violet. It has been likened to that of the spleen.	2. *Color.*—A light reddish tint, in proportion to the degree in which the respiratory process has been performed. Mottling about the anterior surfaces and borders is likely present if the breathing is imperfectly established.

[1] Op. cit.

[2] Casper states that the diaphragm in dead-born children attains its highest point when it reaches the interval between the fourth and fifth ribs. It is well to recollect, also, that putrefactive gases change the position of this muscle.

ngs before Respiration.	*Lungs after Respiration.*
nsistence.—Firm and compact, ; the consistency of the liver. ompression may lacerate their Air-vesicles are not visible ked eye. The bubbles arising mposition may be squeezed out.	3. *Consistence.*—Spongy and crepitant to the feel, air being felt within them. The consistence depends upon the degree to which respiration has been carried. A thin section, under the microscope, shows distinct air-cells. Air cannot be squeezed out.
ight.—Less than after respira- erage weight, four hundred and grains (Taylor), and four hun- thirty to six hundred, according	4. *Weight.*—In three cases it was nine hundred and twenty-seven grains. Taylor mentions a case where the weight was upward of twelve hundred grains; and the organs contained no air, nor did sections of them float on water.
ecific Gravity.—Greater than iration. According to Taylor, eral experiments, the specific is from 1.04 to 1.05.	5. *Specific Gravity.*—Less than before respiration, because the respired air more than counterbalances the additional weight of the blood circulating through the air-cells. According to Taylor, after one experiment, the specific gravity was 0.94.

olor of the lungs before respiration may be changed to a brighter n exposure to the atmospheric air. After a perfect respiratory id a short exposure to air, they become of a bright scarlet hue. ally they assume a marbled appearance, which cannot be produced ial inflation. It is due to the presence of blood in the vessels which the inflated lung-tissue. The color of the lungs may be greatly in case respiration has been imperfectly performed as a result of ease.

important to remark that the lungs of infants that have survived h for some time will occasionally furnish no sensation of crepitation nger, nor will they float on water. These peculiarities are usually lungs which present the other fœtal characters,—*i.e.*, they possess a r, and are of small size. But sometimes cases occur in which the ve all the characteristics of respiration—the light reddish tint and ppearance—and yet will not crepitate under the finger. Crepita- ough furnishing presumptive evidence of breathing having occurred, und in lungs that are decomposed, or which have been artificially with air. Children prematurely born seldom, if ever, possess the s just described, although they may have been alive some days after

medico-legal experts agree that the *weight of the lungs* (static test) to the admission of air thereto is less than after, owing to the of the circulating blood. Reese[1] says that "great weight of the nnot of itself furnish proof of respiration unless accompanied by

[1] Op. cit.

increase of volume from the presence of air, and by crepitation and the distention of the air-cells; it may really be due to disease." It is scarcely necessary to remark that the absolute weight of the lungs remains unchanged, as the air respired cannot produce any material difference other than rendering these organs apparently lighter. The fœtal lungs, if supplied with a very small amount of air, will float in water, no matter whether this supply be afforded by breathing, artificial inflation, or decomposition. The hydrostatic test, as originally performed, depended upon this property.

The Hydrostatic Test (*Docimasia Pulmonum*).—This test, long known in the history of infanticide, is, as has already been stated, based on the fact that the fœtal or unaërated lungs sink when put in water, while the lungs of an infant that has respired, or where they have been inflated artificially, float in water. Various writers consider this test unreliable; but, although it cannot prove respiration absolutely, it furnishes evidence of the aëration or non-aëration of the lungs. It is not an infallible test of live birth, for the infant may have been born alive and not respired; or, if it did, the breathings were imperfectly accomplished. Again, the infant may have respired during its birth and died before that phenomenon was completed. The hydrostatic test, however, proves conclusively the presence or absence of air in the lungs, and establishes a very strong probability of respiration.

The mode of applying the test is as follows. After having removed the lungs, heart, and thymus gland from the thoracic cavity, they should be placed in a capacious vessel containing water at a temperature of 15.6° C. (60° F.). Observe whether they sink or float. If they sink, it should be noticed whether this takes place rapidly or slowly. If they are buoyant, and float, note whether they do so high above the surface of the water, on the level of the surface, or under it. Each lung should next be tried separately, because there may be a difference in their buoyancy. If they sink singly, divide each one into a dozen or more pieces and test separately. If they all sink, it will be fair to conclude that, although life may have existed for a short period after birth, there is no evidence of respiration. If they are sufficiently buoyant to float on the top of the water, they should be compressed separately beneath the surface of the water to note whether air-bubbles are given off, and whether the parts still float. Béclard's mode of procedure is to wrap the divided portions which float in cloth, and place them on the floor with a heavy weight upon them. In this way they are subjected to an equable pressure. Having done this, the pieces are placed again in water to observe whether they still float. If decomposition is far advanced, it is scarcely possible to give a positive opinion.

If the lungs float on the top of the water, there is positive evidence of their complete aëration, and this fact may be regarded as strong proof of breathing at birth. If, however, they float beneath the surface, the aëration is incomplete. If they sink separately and in pieces, evidence that respiration has taken place is *nil*. Imperfect respiration of the infant may be entertained if some pieces float. Hence the conclusions which may be drawn

om this test are that if the lungs float separately breathing has been estabhed, and *vice versa*, absence of air is denoted by their sinking, and respition or the presence of air by their floating.

The *objections* raised against the test are (1) that the lungs may be ated, notwithstanding the fact that the infant has not respired, from artiial inflation, putrefaction, and emphysema ; and (2) that they may sink in ter, although respiration has taken place and the child lived.

In reply to Objection 1, it may be stated that *artificial inflation* of the igs would hardly be attempted in a case of infanticide, since it would be desire of the assailant to prevent respiration rather than to establish it, order to prove that the infant was dead-born rather than live-born. Furermore, his object would be to preserve the fœtal state of the lungs. The actice of artificial inflation would be carried out only in those cases where e infant's life was in jeopardy. The physician or the mother might resort this plan to save the child's life. To artificially inflate the lungs completely next to impossible, since most of the air would find its way into the stomh. The only weight that can be attached to this point is that artificial flation of the lungs might be confounded with imperfect respiration ; it in never be mistaken for perfect breathing. More or less buoyancy, howrer, would prevail in either instance, and crepitation to the feel. If the rgans thus inflated be cut into pieces, many of these will float in water, ad, even after being compressed, still remain at the surface of the liquid. ut it may be stated that, as a rule, if a fragment be strongly squeezed etween the finger and the thumb, if artificially inflated, it will sink. As as been mentioned previously, respiration adds to the actual weight of the ings ; not so, however, if they have been artificially inflated, for the simple eason that the blood is not attracted to them. Again, the color of the inlated lung is cinnabar-red, and the organ possesses no marbling, such as is he case where respiration occurred. This marbling is characteristic of reathing. According to Casper, as quoted by Reese, "when we observe a sound of crepitation of the pulmonary air-cells with hyperæmia, bright innabar-red color of the lungs, without any marbling, and perhaps air in the (artificially inflated) stomach and intestines, we may with certainty conclude that the lungs have been artificially inflated." The stomach and intestines of infants born dead sink in water, as they contain no air. They can, therefore, easily be distinguished from the condition that pertains to artificial inflation.

The possibility of gases that are generated by *putrefaction* being the cause of the lungs floating ought not to occasion much concern, as it would be admissible only in those cases where decomposition is discernible in other parts of the infant's body. Besides, it is comparatively easy to distinguish between the buoyancy of respiration and that produced by decomposition. The appearance of lungs undergoing decomposition is different from those n a healthy state. They are of a greenish-yellow color, possess little or no onsistence, and give off a very fetid smell. It is important to recollect, in

this connection, that decomposition occurs more speedily in other organs of the infant's body than in the lungs, proving that if the lungs do float in water, the buoyancy exhibited thereby cannot be the result of putrefaction. If a piece of the anterior of the lung be placed in water, it will sink at once; and, again, if a portion be compressed so as to force the air out, it will not remain upon the liquid's surface, but will also sink. Crepitation is also absent in lungs which are decomposed. The air resulting from putrefaction does not reach the air-vesicles of the lung, but is found in the cellular tissue, principally between the lobes and lobules. It collects in the form of large bubbles, which are greater in size than the air-vesicles, and which disappear on pressure. Moreover, the distention that putrefaction causes is not so uniform as that following respiration or inflation. When about to employ the hydrostatic test, it is better to secure a portion of the lung from the centre rather than from the surface.

It is doubtful whether *emphysema* can be regarded as a congenital condition of the lungs, causing them to be buoyed up in water, in the absence of breathing. Some medical jurists, however, have offered this as an objection to the hydrostatic test. As there are no authentic cases of the spontaneous development of emphysema within the fœtal lungs, the objection is without foundation, and hence not to be admitted. Dr. Cameron[1] says, "But even if emphysema did occur, the air could be dislodged by pressure, and the appearances would not resemble those which follow natural breathing."

Frozen lungs, although airless, may float; but after being thawed out they sink in water. Lungs which have been placed in alcohol for some time may also remain on the surface of the water for a while; but eventually the alcohol is extracted and they lose their buoyancy.

Objection 2: *Lungs which have breathed may sink.* This may be due (1) to diseases like pneumonia, congestion, and atelectasis; and (2) to very feeble respiration, such as is observed in those cases where the infant had lived for some time. The density of the lungs may be so much increased by pneumonia, congestion, atelectasis, etc., as to cause them to sink if placed in water; but as the first two conditions are very seldom met with in the new-born infant, no great importance should be attached to this objection. Atelectasis may be regarded as the original, fœtal, undeveloped condition of the lung. (Reese.) Œdema and scirrhus may also cause consolidation of the lungs. If any of these affections be found, no difficulty ought to be experienced in their recognition. It is scarcely probable that both lungs would be affected in every part; hence, if divided, some of the parts may be found to float in water. If a portion of a congested lung be compressed between the finger and thumb, so as to remove the blood, it will float.

In those cases of complete non-expansion of the lungs, where the child has lived and respired feebly, the lungs, if divided, may show the presence of air in some of the portions. Feeble or imperfect respiration is usually

[1] Op. cit., vol. ii. p. 172.

found in premature children. The hydrostatic test[1] is not applicable where every fragment of the divided organ sinks. It is, therefore, impossible to

[1] Higgins (*Medical Record*, December 17, 1887) comments upon the fact, which is well sustained, that one of the most trying questions which confronts the medico-legal expert is that of live birth where foul play is suspected. He states that the hydrostatic test is the only conclusive one at hand, and, if properly applied, it may positively affirm whether breathing has or has not occurred. But while the destruction of the child *in utero* is criminal, no punishment is afforded for those who destroy it previous to its complete birth. (Killing the infant after birth is, of course, murder.) Dr. Higgins further remarks, that this holds true even after respiration has been fully established. Since there is no test by which one may be able to determine whether the birth was complete when the child was killed, he reports an inspection of a child that collateral evidence showed was strangled at birth. Death was produced by the choking, not so much by suffocation as by compression of the jugular veins and hemorrhage at the base of the brain, and also by the condition discovered in the heart. Dark, *frothy* blood filled both cavities of the latter organ. The conclusion reached was that the pulmonary circulation at the time of its establishment was lessened by the compression. The heart, still pulsating, had *sucked* in air through the severed umbilical vein. It was unsupplied with blood. This could only have occurred after the complete birth of the infant, and the cord had been divided.

In the *Archiv für Kinderheilkunde*, Band xi., Heft I., Professor S. S. Zaleski suggests a novel method of ascertaining whether an infant is still-born or not. His test is founded upon the following properties. First, the lungs of the fœtus contain only sufficient blood for the proper nutrition of the tissue of the organs, while the lesser circulation is only begun subsequent to birth; and, as a result of this, there is an immediate increase of the pulmonary circulation. Secondly, the blood contains a constituent whose percentage is almost unalterable,—viz., iron. This substance is easily estimated quantitatively. Hence a lung which has respired air contains more iron than one which has not. From the quantity of iron discovered in the lungs, Zaleski believes it may be determined whether the infant was alive at its birth or not. This observer has estimated the quantity of iron in seven cases. In four the children were dead births, while the other three were born alive. In the former instances the average total quantity of solids was 13.22 per cent., and of these, in the recent state, iron was represented by .0110, in the dry state by .0828. Of the cases of live birth the average solids were represented by 15.87, showing in the recent state .0188, and in the dry state .1182 per cent. of iron. The hydrostatic test, which was applied in these cases, was contradictory. In one case, which was assuredly a still-birth, it furnished a positive answer, while in an unmistakably live-born child a negative answer was furnished. The general conclusions drawn were: (1) That the percentage of solids, as well as that of iron, is much less in the pulmonary organs of infants who have not respired than in those children born alive. (2) The difference is notably plain in comparing in each individual case the quantity of iron with the quantity of solids. (3) The difference is very noticeable even in the comparison of averages. (4) The age of the fœtus or child, as it increases, augments the quantity of iron. (5) Diseased conditions of the pulmonary organs have no perceptible influence on the quantity of iron. (6) The imbibition of the tissues of the lungs with blood appears to be without influence on this test. (7) This test has always been accurate, and has never been noticed to act contrary to other tests or to apparent facts. (8) The quantity of iron in the pulmonary organs is dependent upon the respiratory functions, and is augmented in proportion to the activity of those functions. The objections to the test are of no considerable importance, being based

ascertain from the lungs whether life existed at the time of the infant's birth or whether it was dead-born.

2. *Proofs of a Live Birth afforded by the Circulatory Apparatus.*—It is important to have a clear understanding of both the adult and fœtal circulation in this connection, so they are both subjoined. In the adult, and in the child who has respired freely for some time from the mother, the heart consists of four cavities, two auricles and two ventricles, the auricles being separated from each other by the septum auricularum, and the ventricles by the septum ventriculorum. Hence there are two hearts,—a right or pulmonary heart, which takes the venous blood from the venæ cavæ and forces it through the lungs to the left side of the organ, and a left heart, which receives the arterialized blood from the lungs and forces it into the general system. The left side of the organ is the strongest, its walls being much thicker than those of the right side, on account of the extra amount of labor which is forced upon it. The ventricles possess the thickest walls. The function of the auricles is to propel the blood through the auriculo-ventricular orifice, and so supply the ventricles. The manner in which the blood circulates through the heart in the adult is as follows. Passing through the right auricle from the venæ cavæ, it passes from the right auriculo-ventricular opening into the right ventricle, then through the pulmonary artery into the pulmonary organs. It next passes—that is, from the lungs—through the pulmonary veins into the left auricle, and through the left auriculo-ventricular opening to the left ventricle. It then passes through the aorta, and so on through the entire arterial system. In the *fœtus*, the blood starting from the placenta, aërated and well nourished, goes by the umbilical vein to the navel, where it enters the body of the fœtus, and after a short course passes up to the liver, where part of it is split into two streams, one of which supplies that organ, while the other passes along the ductus venosus to the vena cava ascendens, into the right auricle of the heart. Instead of going through the right ventricle, it is directed by the Eustachian valve along the back of the auricle to the foramen ovale to the left auricle, and thus enters the left ventricle, which forces it into the general circulation. The difference in the circulation of blood in the inferior vena cava from that of the superior vena cava is that the blood forced back from the head or superior vena cava

merely upon theoretical grounds. However, further investigations will be required before any positive opinion can be formed as to whether the various pathologic changes of either the mother, child, or fœtus will possess an influence on the quantity of iron in the lungs, such as anæmia, leucocythæmia, etc., where the iron is diminished, or diabetes, where it is increased. It is important to recollect that serious hemorrhage may follow through neglect in ligating the umbilical cord. This would also reduce the quantity of blood, and hence the quantity of iron in the pulmonary tissues. The test may also be applied to lungs which are undergoing decomposition and where artificial respiration has been attempted. In the latter instance it must be ascertained whether the process had introduced air into the alveoli or led to the introduction of blood into the pulmonary circulation.—*Therapeutic Gazette*, November, 1889.

into the right auricle and enters the right ventricle. (The blood from ferior vena cava does not enter this ventricle.) Upon contraction of ght ventricle, the blood is forced into the pulmonary artery, and d by the ductus arteriosus into the aorta, just beyond the point the left subclavian is thrown off from that vessel. Therefore, in the state, the blood may be said to be forced by the right ventricle and t auricle through the general circulation. From this it will be seen e blood in the aorta is partially aërated,—that is, about one-half of it l the remaining half is not.* The blood returns to the placenta to be hed and oxygenated through the descending aorta, the common iliacs, e umbilical artery. At birth, and when respiration is fully established, is freely transmitted through the lungs. Since there is no further f the ductus arteriosus, it contracts and shrivels, remaining only as a s cord. At the same time that the detachment of the placenta takes the passage of blood from the umbilical arteries is arrested. No flow along the umbilical vein, and the ductus venosus contracts the cur- of the superior and inferior vena cava mixing in the right heart, and ustachian valve and foramen ovale become useless.

e prenatal circulation, therefore, is found to be totally different from ubsequent to the birth of the child. The circuit of the blood is per- d by means of the foramen ovale, the ductus arteriosus, and the ductus us, without being subjected to oxygenation in the lungs. Hence, upon e of these orifices, the extra-uterine life of the child is begun, and the ce of life subsequent to birth established. The time at which the fora- loses is usually at birth, or soon after, but cases are recorded where continued open up to adult life, and even throughout life. The e of the ductus arteriosus is not invariably a proof of live birth, nor occlusion positive evidence of dead birth, as its closure may be either al or protracted. The ductus venosus often closes sooner than the apertures, but it is not a very certain sign of live birth. The um- vessels, which consist of a vein and two arteries, are occluded and rated after birth, but the exact time at which the closure is effected is ly more certain than in the case of the other apertures.

luable evidence of live birth is afforded by the *drying up of the um- cord*, particularly if life has lasted for some days. After ligation the ecomes dull, loses its prenatal polish, desiccates, and shrivels. In four e days it separates by dry or moist gangrene. The umbilical vessels e closed, and the stump is healed when the cord cicatrizes in a few The time of its falling off is subject to great variation. If pulsation ceptible in the cord after complete birth, the existence of life is positive. ation has not been effected, pulsation of the cord may be apparent two re minutes, or even longer, provided the attachments between the ta and uterus remain unaffected. Reese[1] says that "the existence of

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[1] Op. cit.

an inflammatory zone about the umbilicus is one of the signs of medico-legal importance in judging whether an infant has lived after birth. . . . Although the separation of the cord is a vital act, and can occur only in a living child, its desiccation may take place equally in a dead child, although it occupies a much longer time in the latter, sometimes not commencing for several days after birth. But the important point of distinction between the two is that spontaneous separation of the cord never occurs in a dead-born child; it merely withers and dries up, but remains attached. Hence the desiccation and separation of the cord, and the subsequent cicatrization, afford positive proof that the child was born alive, and had continued to live some days after its birth."

3. *Proofs of a Live Birth afforded by the Organs of the Abdomen.*—The *liver*, in the fœtal body, is relatively enormously large and quite vascular. According to Meckel, it diminishes in weight (absolute) until the termination of the first year after birth. It is suggested by Bernt that this loss of weight be made a test of live birth; but the test is altogether useless, as there are no means of determining the prenatal weight of the organ, and hence no way of ascertaining the loss sustained subsequent to birth.

Proof of live birth may be derived from the condition of the *stomach* and *intestines*. (Breslau's test.) These organs, in their fœtal state, contain no air. After birth, however, as soon as breathing takes place, air enters them. By the use of a hydrostatic test, similar to that proposed for the lungs, Breslau claimed that the amount of air in the stomach and intestines, and the distance to which it spreads, are proportionate to the extent and duration of respiration. "This test," says Cameron,[1] "has been found particularly useful where air has been prevented from entering the lungs by foreign bodies or occlusion of the bronchi. When respiration is impeded or imperfect, air enters the stomach in larger quantity and extends farther down into the intestine than when respiration is fully and speedily established." The access of air to the stomach and intestines after birth is due to aspiration or deglutition, but it may be forced into the stomach by artificial inflation. Again, air may gain access by absorption, and gases as the result of decomposition. Notwithstanding these objections, the presence of air in these organs, as indicated by their buoyancy in water, may be accepted as an indication of live birth. To apply this test, the stomach should be tied at each extremity before opening it. The section of intestine is treated in a similar manner.

The presence in the stomach of blood, urine, meconium, liquor amnii, etc., affords evidence of life shortly before or at birth. Live birth is not, however, indicated by the presence of these liquids in the stomach. Positive proof that the child was born alive is afforded if the material discovered in the stomach be of such a nature that its presence cannot be accounted for in any other manner than that it was ingested after birth. Such substances

[1] Op. cit.

are milk, farinaceous and saccharine articles. By means of the microscope identification of milk may be readily effected, but it will be found impossible to ascertain whether it be mother's or cow's milk. The discovery of colostrum corpuscles would, however, afford evidence that the milk was derived from a recently delivered woman. By means of *Trommer's test* the presence of *lactine* may be determined. The suspected substance should be diluted, and then treated with a weak solution of cupric sulphate and liquor potassæ in excess. This is next boiled, when the red oxide of copper is thrown down. Recognition of farinaceous matters may be effected by applying tincture of iodine, which gives to the mixture a deep-blue color. The microscope also enables the examiner to identify the particular variety of starch. The *test for sugar* is applied in the manner mentioned for detecting milk; but, previous to its application, a concentrated aqueous extract should be made of the contents of the stomach. If food is found in the stomach and intestines partly digested, and the meconium has all passed away, it may be stated that the infant had lived at least twenty-four hours, and had been fed. The absence of meconium and urine from the intestines and bladder respectively is not an absolute sign of live birth, since it is possible for these fluids to be discharged during parturition. Cameron[1] says that *stains of meconium* on the clothing are occasionally of importance. "They are brownish green, stiffen the fabric, are raised above the surface, but do not always penetrate deeply into it. With water they form a greenish solution which is acid and unaffected by boiling. If the stains have been made by fæcal matters, the color, odor, and reaction give evidence as to the age of the child."

If the child was born alive, how long did it survive? The signs of survivorship for short periods subsequent to birth lack precision; but after the second or third day there ought to be no real difficulty in determining the fact. The medical examiner should, however, be extremely cautious in venturing an opinion, which, if entertained, should be of a very guarded nature. The most valuable information is obtained from the *umbilical cord* and the *navel.* The following arrangement includes the principal facts relative to this question:

(1) From a few minutes to some hours after the birth of the child frothy fluid will be found in the stomach and clots in the vessels of the cord.

(2) After twenty-four hours the coats of the umbilical arteries near the navel will be found in a contracted and thickened condition. The skin is not so red, but is pale and firm. There is some shrivelling of the cord, although it still retains its pliancy and bluish tint, from the point of ligature to its insertion in the abdomen. Greenish mucus will be noticed on the surface of the large intestine, although the meconium is discharged. The superficial epithelium is usually shed during this period, but it may not occur until the second day. It accounts for the paleness referred to. The *caput*

[1] Op. cit.

succedaneum[1] is not always present, but its persistence post mortem may furnish valuable evidence that the infant did not live for more than a few hours, if that long. Care should be taken not to confound a cephalæmatoma with it, as these bloody tumors often remain for months. More or less air may distend the lungs, and if they are perfectly distended the infant has probably survived several hours. The converse of this is not, however, always true. The presence of a very small quantity of air in the child's lungs would not necessarily prove that death occurred instantly after birth.

(3) After the *second day* the greater part of the umbilical arteries will be found in a state of contraction. Exfoliation of the epidermis takes place, if it has not already occurred. The skin is of a yellowish color, and the umbilical cord becomes of a brownish tinge, and is dry between the point at which it is tied and the abdominal wall.

(4) From the *third* to the *fourth day* there is evident shedding of the epidermis of the chest and abdomen. The umbilical arteries are in a state of contraction to their termination in the iliacs. The umbilical veins are also slightly contracted. The color of the cord is brownish red. It is flattened, partially transparent, and twisted. The skin in contact with the desiccated portion presents an inflamed red ring, accompanied by a slight purulent discharge. It is important to remember that this condition has been noticed in both still births and dead births. Traces of green mucus are no longer apparent in the colon.

(5) From the *fourth* to the *fifth day* there is separation of the umbilical cord. Various portions of the body show separation of the skin in the form of fine scales or powder.

(6) After the *fifth day* the contraction of the umbilical veins is complete. If cicatrization of the umbilical aperture is perfect and it is healed, it is possible that the infant survived its birth from three weeks to one month. The ductus arteriosus may be contracted in both its diameter and length, and partial occlusion of the foramen ovale may be noticed.

(7) From the *sixth* to the *twelfth day* desquamation of the epithelium on the limbs will be found. Where the cord was small in size, cicatrization will have occurred before the tenth day after birth. If large, there may be a sero-purulent discharge lasting sometimes for from twenty to thirty days. There is generally complete occlusion of the ductus arteriosus during this period, although there are exceptions. Increase of the weight of the body is apparent. After the eighth day all of the fœtal apertures become obliterated. From the tenth to the twelfth day the ossific centre of the femoral epiphysis will measure more than one-fifth to one-fourth of an inch. Taylor says that the changes which take place in the umbilical cord during the first twenty-four hours may be noticed in the dead body as well as in the living.

[1] The tumor usually subsides within from twenty-four to forty-eight hours after the birth of the infant.

dy[1] observes that there are certain conditions worthy of record,—viz., the esence of food in the stomach, the depth to which air has penetrated the testines, and the existence of meconium. These conditions are, he states, of doubtful value in deciding a child's age." In conclusion, the same auority says, "We need only remark, supposing a child to have been born ive, and the question be asked, *How long a period has probably elapsed ince death?* that, as in the case of adults, we must be guided in forming ur opinion by (1) the extent to which the cooling of the body has proressed, and (2) post-mortem rigidity; or (if the time be past for observing iese) (3) the stage of putrefaction reached. And here the season and the xtent of the exposure of the body to the air must be considered, rememering that the body of an infant decays more rapidly than that of an adult. n water (where infants are often found) decay is slower than usual if the nmersion be complete, while it is more than usually rapid if the body be ne-half in air and the other half in water."

Proofs that the Child has breathed.—These have been considered.

Viability.—By this is meant the capacity of living after birth. (*Vide* egitimacy.)

Was the death of the infant due to natural causes or to vioence? It should be remembered in this connection that nearly twenty per ent. of deaths of infants occur before or just after birth from causes other han criminal violence. The death-rate is still greater in premature births, he rate depending on the degree of prematurity. More deaths occur in first bors than in the subsequent ones,—probably one in eleven in the former nd one in thirty-one in the latter. (Jewett.) The proportion of dead or till births amounts to one in eighteen or twenty of legitimate infants, of llegitimate children one in ten. Hence the importance of noting these acts.

The causes of death in the new-born child are various. It may be due o fœtal or maternal disease, such as operate during birth, and also such as ct subsequently (accidental or criminal). The only causes which can be ssigned in a case of infanticide are, of course, such as are criminal. But om the foregoing facts it becomes evident that the medical witness should e thoroughly conversant with the natural causes of death in the new-born estimating the probability of death from other sources.

Fœtal Disease.—Not infrequent causes of death in the new-born child e such congenital affections as rickets, leukæmia, rheumatism, cardiac disses, general dropsy, scirrhus, infectious diseases (syphilis, scarlet fever, nall-pox, pneumonia, tuberculosis, etc.). Others are pulmonary apoplexy, electasis, sepsis, erysipelas, softening of the brain and spinal cord, pleuic effusion, and tetanus of the laryngeal or respiratory muscles. These thological conditions ought to be readily detected. Of all fœtal diseases, philis probably causes the most deaths.

[1] Op. cit., vol. iii. p. 178.

Maternal Disease.—Premature expulsion of the fœtus is often the result of acute diseases in the mother. Death may take place speedily, directly from the poisonous influence of the affection, or as the result of high fever, or from the effects of the malady upon the circulating blood of the mother. Other affections, although slower in their action, are nevertheless equally sure to end in death. Such diseases are syphilis, scirrhus, phthisis, albuminuria, etc. The question may arise, How long may an infant live *in utero* subsequent to its mother's death? If the illness of the latter be protracted, the fœtus generally dies before the mother; but if the latter die suddenly, the child generally lives for a period which rarely exceeds six months after. Gazerky reports three hundred and seventy-nine Cæsarean operations after the death of the mother, of which thirty-seven infants gave evidence of life, and thirty-four were rescued alive, five of whom survived. His conclusions, based upon Breslau's experiments on animals, are: (1) the fœtus may outlive the sudden death of the mother; (2) if extracted within six minutes of the mother's death, the fœtus may be born alive; (3) if extraction be delayed from ten to twenty-six minutes, the infant may be born alive, but will be highly asphyxiated; (4) if the extraction be delayed for from six to ten minutes, the infant will be probably asphyxiated. In most instances the infant will be more or less asphyxiated after one minute following the mother's death, if it be alive at the time.

The medical witness may be asked to state which survived the other when both the mother and infant die a few hours after the completion of labor. This is a difficult or impossible point to determine.

The pathologic conditions of the placenta that are liable to produce fatal results in the fœtus are degeneration of the chorion villi, thrombosis, apoplexy, and retroplacental bleeding. Sometimes the death of the infant may be due to hydramnios.

Protracted labor is one of the most frequent causes of the death of the fœtus. This is especially true in first labors, since the infant is very apt to be a large one, frequently necessitating the use of forceps. The death may be ascribed to congestion of the brain, or to an insufficient blood-supply following great pressure of the cord. Furthermore, the placenta may be partially separated from the uterine wall by the action of the uterus, causing death. In cases of delayed labor the head of the child will be unusually elongated, the caput succedaneum being quite large. Pelvic deformity in the mother, rigidity of the soft parts, or peculiarities of the infant's structure may all cause death. The autopsy will show congestion of the cerebral blood-vessels.

Debility, or where the infant is constitutionally feeble, is a common cause of death, both during or shortly after labor has been completed. The greater the immaturity the less chance is there of live birth. If such births do occur under these circumstances, the child soon dies from its debility, whether born at full term or prematurely. Cameron states that if the infant be mature and well developed, and the autopsy reveals well-expanded pul-

onary organs, "the plea of congenital debility would not hold as a cause [death."

Hemorrhage from the umbilical cord, from accidental rupture during the irth of the child, or after its section, is occasionally the cause of death in he new-born. If breathing has been established, the hemorrhage is not kely to end fatally. Instances are on record, however, where death has reulted in these cases. A child may die from a *sudden separation of the lacenta*, in which case it will show a waxy appearance, together with paleess and dryness of the internal organs. These appearances are not, howver, exhibited if the body be far advanced in decomposition. Death is iore likely to occur when the cord has been severed with a sharp instrument ian when it has been lacerated. This is especially true if the section be iade close to the abdomen. Children are often suddenly and unexpectedly orn, and dropped accidentally on the floor or ground, rupturing the cord, ut without suffering from the effects of hemorrhage, proving beyond doubt iat a torn cord is less apt to occasion bleeding therefrom than one which as been incised.

Taylor[1] says that hemorrhage from the vessels of the umbilical cord may ause death a few days after the child's birth, even after the greatest attenion, and the cord has separated naturally. The bleeding is probably due to deficiency of fibrin in the blood, thus hindering its coagulation.

Medico-legally it may be of importance to know whether the cord was ut or torn. Cameron says that "cutting or tearing may generally be disinguished by a careful microscopic examination of the free end. If the cord dry and hard, the end should be soaked in cold water for eight or ten iours, and then the examination can generally be made satisfactorily. In ases of doubt the cord should be preserved on a glass plate or clean white aper; it can be soaked and examined months afterwards, if necessary. ections can be made, and the relations of the arteries and veins and the egree of decomposition accurately determined. It is doubtful whether any liable case is recorded of a cord partially cut and partially torn. Such a ndition might be possible if the mother tried to cut it with a dull knife, id, impatient at the delay, finally tore it asunder."

The length of the cord is about eighteen to twenty inches, although it ay exceed this. Tyler Smith mentions a case where it amounted to fiftyne inches in length. Reese states that "in ordinary cases of delivery in e upright posture, the child may fall a distance of twenty-eight to thirty ches to the ground, without putting a strain upon the cord. But in most stances of this nature this distance would be diminished by the woman ininctively assuming more or less of a bending position at the moment of :pulsion. Still, it might happen that the cord might be unusually short, or se wound round the child, in which case it could easily be ruptured. The oint at which the rupture usually occurs is a few inches from the umbilicus.

[1] Op. cit.

In some instances of sudden traction, where it does not break, the placenta attached may be dragged out by the weight of the child." [1]

Compression of the Umbilical Cord.—This may happen where a child is born by the feet or breech. In these cases arrest of the circulation between the mother and child takes place, and the latter soon dies. When the cord becomes twisted about the child's neck during delivery, the same result follows, although fatal cases are recorded of compression of the cord as a result of its being wound round the neck of the infant *in utero* and previous to parturition.

The effects of the cord on the neck are not exactly like those produced in strangulation where respiration has occurred; and, says Reese, "Inasmuch as infants are not unfrequently purposely strangled after the birth of the head, and before the remainder of the body is expelled, it becomes important to comprehend if there are any means of distinguishing between the two cases. If there were no signs of respiration when the child was strangled, it would be impossible to distinguish it from death caused by the constriction of the umbilical cord, except there be marks of the ligature about the neck. *Is it possible for the cord to leave such a mark upon the neck?* It is rare, indeed, that the cord leaves a mark similar to that resulting from a ligature in strangulation. Instances are recorded, however, where positive marks upon the neck were made by the cord. These showed a mere furrow, and again distinct lines of a red or blue color, sometimes singly, and at other, two or three parallel ones. A true ecchymosis is very rarely seen as a result of the compression superinduced by the cord." Reese further states that, if the neck be short and the body has been kept in a cool place, furrows and ridges may be formed in the folds of the skin, which might suggest strangulation.[2]

Congenital malformations may be the cause of the child's death. Deficiency of some vital organ would at once account for the fatality. It is well known that *monsters* possess little vitality, and hence die soon, although not necessarily instantly after birth. The law does not sanction the destruction of these malformed children, and, as Taylor remarks, "The presence of all marks of violence in such cases should be regarded with suspicion." The following case is reported by Taylor.[3] "A lady was delivered of a most hideous dicephalous monster. In the absence of the medical attendant, and at the earnest solicitation of the friends, the nurse destroyed it. The question was, Was this woman guilty of child-murder? The only case in reference to this point is that of two women who were tried for drowning a child that was born with some malformation of the cranium, in consequence of which it was likely that it could not have survived many hours. There did not appear to have been any concealment on the part of the accused women, who were not aware of the illegality of the act, and they were acquitted." Although the absence of malicious intent would very likely lead to acquittal, as in the case just mentioned, the act might result in a

[1] Medical Jurisprudence. [2] Ibid., p. 524. [3] Op. cit., p. 358.

nviction of manslaughter. The fact that the child or monster is not likely survive a few hours would not justify its premature destruction.

Fractures of the cranial bones sometimes occur as the result of difficult precipitate parturition. They are not necessarily evidence of homicidal olence. They may also be occasioned by a disproportionate size of the ad of the infant, or by some deformity of the maternal pelvis. Again, they ay be the result of the use of forceps. These cases of fracture of the skull e extremely rare, since the great play of motion afforded the cranial bones lows great pressure upon them without producing dire results. It somemes happens that a defective ossification of these bones is mistaken for acture.

Was the violence accidental or criminal? The criminal modes r the purpose of destroying the life of the new-born child are suffocation, rowning, cold and exposure, starvation, wounds, fractures, and other inries, luxation and fracture of the neck, poisoning, intentional neglect to gate the umbilical cord, causing the infant to inhale noxious gases, the troduction of instruments into various parts of the body, etc.

Suffocation is the easiest and most common mode of destroying the newom child. According to Tardieu, four-fifths of the deaths from infanticide re clearly the result of asphyxia in some one of its forms. Of four hundred nd forty-four cases, two hundred and eighty-one were caused by suffocaion. This means of killing the child may be effected by *smothering* it, or y neglecting to remove it from the maternal discharges. Furthermore, eath may follow neglect to remove the child from the membranes which ccasionally cover it, or to displace the mucus from its mouth and throat. reathing may also be prevented by forcibly closing the mouth and nostrils. gain, the infant may be suffocated by the aspiration of meconium, blood, r fæces during its birth. In some cases obstruction of the respiratory pasges is effected by the infant being born in a privy-vault or closet. In such stances the passages will be obstructed by fæcal matter, water, dirt, etc. otton, wool, feathers, clay, hay, handkerchiefs, etc., have been employed r the purpose of obstructing the respiratory passages. Even liquids have en used. Reese says that in one case dough had been forced down the roat in order to obstruct the larynx; in another wet sand was applied to e back part of the throat; and in still another instance obstruction was ected by means of cinders.

Many of these cases are involved in great difficulty when it comes to stinguishing whether the death resulted from accidental or criminal causes. very careful examination must be made of the air-passages in order to termine the exact cause. If the death be the result of accident, there ght to be no marks of violence on the body of the infant. Marks may be und, but they would be of such a nature as to dispel the idea of attempts ving been made upon the infant's life. It is not always possible for the edical examiner to give an opinion as to the cause of death in these ses unless some circumstantial evidence be furnished. If, however

from suffocation be evident, it must be recollected that it is not necessarily due to a criminal act. As Hunter (quoted by Taylor[1]) says, "When a woman is delivered by herself, a strong child may be born perfectly alive, and die in a very few minutes for want of breath, either by being on its face in a pool formed by the natural discharges, or upon wet clothing, or by the wet things over it collapsing and excluding air, or drawn close to its mouth and nose by the suction of breathing. An unhappy woman delivered by herself, distracted in her mind and exhausted in her body, will not have strength or recollection enough to fly instantly to the relief of her child." To which Taylor adds that "a primiparous female may faint or become wholly unconscious of her situation; or, if conscious, she may be ignorant of the necessity of removing the child, and thus it may be suffocated without her having been intentionally accessory to its death."

On the trial of a woman for the killing of her infant, the evidence showed that the child had dropped from her while in a privy, and, as a result, it had been suffocated. The court held that if the jury was of opinion that subsequent to its birth the mother was possessed of the power of procuring such assistance as might be the means of saving the infant's life, she was guilty of manslaughter.[2]

The post-mortem appearances after fatal suffocation in infants are like those seen in adults, if breathing has been established. Ecchymotic patches may be seen on various parts of the skin. These are of a general livid color, and the face is considerably swollen. The superficial veins are turgid. The eyeballs protrude and the conjunctivæ are injected. If respiration has been established, bloody mucus, which is frothy, will be noticed about the nostrils and mouth. The internal organs are engorged with blood, especially those of the thoracic cavity. Punctiform ecchymoses are observed beneath the pleura, pericardium, endocardium, peritoneum, and bronchi. It is rarely the case, in death from smothering, that lesions are discovered other than those of internal origin. Jewett[3] says, "The ecchymotic spots of suffocation must be distinguished from those of cholera, purpura, and grave forms of eruptive fevers. In the former the ecchymoses present a dotted appearance, and the spots are rounded, clear-cut, and distinctly circumscribed. In the latter they are irregular effusions of a purplish color, and are associated with the characteristic lesions of the disease."

Infanticide by strangulation is common. Constriction is effected by ligature or by compression with the fingers. Cases are on record where the infant was strangled by tying the umbilical cord round the neck. The usual defence offered in these cases is that death was caused by the coiling of the cord about the neck or body of the infant, or that the ligature was so placed to aid in the birth of the child. This would, however, be disproved if the lungs showed evidence of respiration. As a general thing, death may be

[1] Op. cit. [2] Reg. *vs.* Middleship, 5 Cox C. C. 275.

[3] Op. cit., p. 492.

ted to be caused accidentally if the lungs are found to be in their fœtal te, and homicidally when signs of breathing are evident. In criminal angulation greater violence is employed than is necessary; hence the im-ints of the fingers and nails or the marks of the ligature used are shown. he skin at the seat of constriction may be torn and abraded, and ecchy-oses evident about the marks of the ligature. The superficial structures ove and below the marks of constriction may be œdematous; but it must remembered that such signs may be absent in these cases and present in cidental strangulation. As a rule, however, the lividity and ecchymoses the latter cases are only slight and partial, whereas in criminal cases the eater violence used produces a much deeper, broader, and more ecchy-osed mark. As Cameron remarks, "It is entirely a question of degree, it it is improbable that the cord could be accidentally tightened during rth so as to produce marks resembling those resulting from criminal olence, while at the same time the child is able to breathe sufficiently to pand its lungs fully with air."

The autopsy reveals a congested and œdematous face, with protrusion of e eyeballs and ecchymotic spots upon the conjunctivæ. These latter, owever, may be produced by causes other than strangulation. The deeper ructures will be found to be effused with blood. The lungs may be en-orged with blood or in a normal state. They may also show evidences of nphysema and apoplexy. The brain and its meninges are in a state of tense congestion. The only marked difference between suffocation and rangulation is the absence of œdema and venous engorgement in the former.

It may be claimed by the defence that the injuries to the child were in-icted by the mother, without criminal intent, in her efforts to aid parturition. he writer was recently summoned to a case where the birth of the child as completed. He found it gasping and emitting bloody froth from the outh. Further examination showed distinct finger-marks over the larynx d trachea, the presence of which was explained by the mother to be the sult of her efforts to deliver the infant. The mother was a single woman, d had every reason to prevaricate. In such a case strangulation would be possible unless the child had breathed. If the mother really intended to d in the delivery of her child, such efforts would be necessary only while rt of its body was still within the uterus; in which case respiration would ll be kept up through the placenta.

Drowning is seldom practised as a mode of committing infanticide, yet ses are recorded where the new-born child was destroyed in this way. less the fact of respiration be proved, this mode of death cannot be en-tained. The signs of drowning, after breathing has been established, are nilar to those presented in adults. The fact of the dead body of an infant ing discovered in the water does not of itself prove that this was the de of death. In most of these cases death was caused by some other form violence previous to the placing of the body in the water. The medical aminer should make a very exhaustive and careful examination of the

body, in order to determine what was the real cause of death, and it is important to recollect that it is not necessary that the entire body of the child be submerged in order to cause death by drowning.

Children are sometimes suffocated by being placed in mud or in the soil of a privy-vault, or they are killed in some other way, and then thrown into such places for purposes of concealment. "In all cases of drowning," says Jewett,[1] "it is extremely difficult to determine by the medical evidence alone whether death was due to accidental or criminal causes. In case of alleged drowning careful search should be made for marks of violence such as obtain in other homicidal methods. The body should be examined for proofs of suffocation or strangulation, and for other evidence of violence, accidental or criminal. The fauces and trachea should be searched for obstructing material which may have been placed there with criminal intent, as well as for the usual causes of asphyxia by accident in the new-born. The presence in the stomach of liquid or other material like that contained in the vault would be proof positive that the child was living when thrown into it. These substances could have gained access to the stomach only by the act of swallowing. In the dead body they would go no farther than the mouth and nares."

Cold and exposure are sometimes resorted to for the destruction of the infant. Examination after death may reveal no indications as to the cause of death, with the exception of cerebral congestion, which is occasionally noted. Death may, however, be ascribed to cold if the body of the infant be found discolored, shrivelled, and frozen stiff, and its lungs show evidences of breathing having occurred.

Starvation is much more difficult to prove than death from exposure to cold. If the body be much emaciated and shrivelled, the face pale and wrinkled, the countenance suggestive of pain, etc., under such circumstances death may be ascribed to starvation; although, as has been already stated, it is difficult to prove, as it is frequently a factor in death from exposure. In some cases it will be necessary for the examiner to test the stomach and intestines for food.

Wounds and other injuries may be the cause of the infant's death. They are occasionally seen on the body in cases in which death was due to other causes. They may be inflicted accidentally or criminally, and, further, they may be made before or after the death of the child. They are usually very rapidly fatal, and present appearances similar to those in adults. As a rule, they furnish no external signs of their presence, such as inflammation, etc. The evidence of a coagulum under or about such an injury is the best proof of its ante-mortem character, since its presence indicates that the blood was in circulation at the time of the infliction of the wound. If, however, the blood extravasated be fluid, the supposition would be that the wound was of post-mortem origin if the body of the child be still warm.

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[1] Op. cit., vol. ii. p. 493.

Accidental wounds on the child may result from labor, in which case they would be situated about the presenting part of the child. Jewett says that "abrasions, ecchymoses, and even lacerations of the skin are frequently found after difficult births, even in the absence of instrumental interference." Minute incisions and punctures may easily cause the death of the child, as where needles or other delicate instruments are thrust through the fontanelles, etc. In such cases it is often extremely difficult to determine the exact cause of death, on account of the minute character of the puncture. Cameron says that "incised wounds may be attributed by the defence to broken utensils, surgical instruments, or the accidental slipping of knife or scissors while cutting the cord. In that event the wounds are not likely to be multiple, or extensive, or accompanied with much violence, and the cord would be found cut, not torn." In some cases the child's body will be found dismembered, and the allegation in defence will be that it was so treated in order to conceal the birth, it having been born dead. To prove the truth or falsity of such an allegation, the medical examiner should apply the tests for live birth. When wounds have been extensive and hemorrhage severe, the marks of extreme anæmia will be apparent. (*Vide* Wounds.)

Luxation and fracture of the neck are causes that occasionally operate in infanticide. In such cases the accused may allege that the death of the child was the result of accident while attempting to deliver it. Cases are on record where the death of the infant was ascribed to intra-uterine injury, such as luxations of the hip- and knee-bones, following injury to the mother. Evidence of criminal interference can be established in these cases only by the attending circumstances.

Hanging is rarely resorted to as a mode of killing the new-born child, although cases are on record. (*Vide* Hanging and Strangulation for the distinguishing marks between strangling and hanging.)

Poisoning is also a very rare cause of death in infanticide cases. Cases are recorded where mothers have poisoned their offspring by means of opium in the form of soothing syrup. Furthermore, caustics have been criminally introduced into the mouth. Phosphorus and arsenic have also been administered for the same purpose.

Mode of conducting the Post-Mortem Examination.—In examining the bodies of new-born children, the greatest care should be exercised by the medical examiner, especially in cases of infanticide. He should determine the age of the infant, whether it was a live or dead birth, how long it has been dead if born alive, and what caused its death. Other points to be noted, besides the ordinary lesions of disease, are the sex, length, and weight of the child; state of the umbilical cord; degree of putrefaction; condition of the surface of the body (whether smeared or not with blood, meconium, or foreign matters); presence and position of vernix caseosa; congestion of the face (ecchymoses of conjunctivæ); whether there be marks of violence on the body; whether there are any subcutaneous ecchymoses; and the dimensions of the head, thorax, and shoulders.

Internal Examination.—Note the shape and condition of the thorax; inspect the surface of the *lungs;* note their color, the presence of subpleural ecchymoses, patches of emphysema, or putrefaction; ascertain their absolute and specific weight and their volume. Apply the hydrostatic test. Observe the position of the *diaphragm* and the condition of the *heart* as to the foramen ovale and ductus arteriosus, and also the ductus venosus and the umbilical vessels. Note the quantity of fluid or coagulated blood within its cavities. In the abdomen, note the *stomach* and *intestines;* ascertain whether the latter contain gas, and the quantity of meconium in the large intestine; notice whether the anus be imperforate or not. Note the degree of congestion of the *liver* and the state of the *kidneys* (uric acid infarctions); also examine the *bladder*, whether empty or full, etc. The different parts of the *brain* should also be carefully examined as to its degree of congestion, etc.

The Autopsy.—The following is taken from Delafield's and Prudden's "Hand-Book of Pathological Anatomy and Histology," and furnishes the proper order in which to conduct the post-mortem examination upon a new-born child for medico-legal purposes. (For the determination of the size and age of the fœtus, *vide* p. 451.)

The Head.—The fontanelle and sutures should be first examined as to their size and for penetrating wounds. An incision should then be made through the scalp across the vertex, and the flaps turned backward and forward as in the adult. With a small knife the edges of the bone should be separated from the membranous sutures and the dura mater, beginning low down in the frontal and going back into the lambdoidal suture on either side. The bones are then drawn outward and cut through around the skull with strong scissors. The brain is removed and examined as in the adult. Effusions of blood—cephalæmatoma—may be formed soon after birth between the pericardium and bone, or more rarely between the dura mater and skull; between the dura and pia mater; more rarely in the substance of the brain, as the result of protracted or instrumental deliveries, or of injuries after birth. The cranial bones may be malformed, or exhibit the lesions of rickets or caries, or be indented, fissured, or fractured. These latter lesions may be produced during intra-uterine life by injuries to the mother, by unknown causes, by difficult deliveries, or by direct violence after birth. In cases of chronic internal hydrocephalus in young children, in which the ventricles are much dilated and the brain-substance thinned over the vertex, the brain is very apt to be torn in removal, and the amount of dilatation thus becomes difficult of determination. It is, therefore, better in such cases to place a pail of water beneath the head, or even immerse the latter in it, and remove the brain in the water. In this way it floats after removal, supported on all sides. It may now be opened in the water and the extent of the lesion determined at once, and parts saved for microscopic examination. If it be desired to preserve the brain for demonstration of the lesion or for a museum specimen, it should be transferred open to a large jar containing a mixture of equal parts of alcohol and water. A portion of the ventricular fluid

hould now be removed with a syringe provided with a small canula, and eplaced by strong alcohol. The fluid in the jar, as well as in the ventricles, hould be changed in forty-eight hours, and then gradually increased in trength until the organ becomes hard. The brain may then be cut transersely across, when the degree of dilatation of the ventricles, etc., will be evealed. The brain, of course, shrinks considerably by this process, but he relative proportions are approximately preserved. The brain is normally much softer and pinker than in the adult, the pia more delicate ; both may be much congested or anæmic without known cause. The ventricles contain very little serum. Malformations, apoplexies, hydrocephalus, simple and tubercular inflammatory lesions, are to be looked for.

The Spinal Cord.—Extravasations of blood between the membranes of the cord may occur from the same causes as those in the brain. Spina bifida is the most frequent malformation.

The Thorax and Abdomen.—These are opened as in the adult. The *peritoneal cavity* contains a very little clear serum. A red fluid may be produced by decomposition. The peritoneum is often the seat of intrauterine inflammation.

The Diaphragm.—In still-born infants its convexity reaches to the fourth or fifth rib. After respiration it reaches a point between the fourth and seventh ribs. Its position is, however, so variable that it is of little diagnostic importance.

The Thorax.—The *thymus gland*, at this period very large, occupies the upper portion of the anterior mediastinum, covering the trachea and large vessels. Its average weight is about half an ounce. It is usually about two inches long, one and a half inches wide at its lower part, and about onequarter to one-third inch in thickness. It may be hypertrophied and compress the large vessels, or be inflamed and suppurating.

The *heart* lies more nearly in the median line than in the adult. It weighs from one and a half to three and a half ounces. The ventricular walls are nearly of equal thickness. The pericardium contains very little serum. A considerable quantity of red fluid may accumulate here as a result of decomposition. There may be small extravasations of blood beneath the pericardium in still-born children and in those born alive. Pericarditis with effusion of serum and fibrin, and endocarditis with consequent changes in the valves, may exist before birth. Malformations and malpositions of the heart-cavities and large vessels are not infrequent. The time of closure of the foramen ovale and the ductus arteriosus varies very considerably in different cases.

The *pleural cavities* contain very little serum, but decomposition may lead to the accumulation of a considerable quantity of red fluid. Small extravasations of blood in the subpleural tissue may be found in children who have died before birth and after protracted labors. Inflammation, with exudation of serum, fibrin, and pus, may exist before birth.

The *lungs* in a still-born child are small, do not cover the heart, are situ-

ated in the upper and posterior portion of the thorax, are of a dark-red color and of firm, liver-like consistence, and do not crepitate. In a child born alive, and who has respired freely, the lungs fill the thoracic cavity, but do not cover the heart as much as in the adult; they are of a light-red or pink color, and crepitate on pressure. If respiration has been incompletely performed, we find various intermediate conditions between the fœtal and inflated states. If any doubt exists as to respiration having taken place, it is customary to employ the hydrostatic test. The lesions of inflammation and vesicular and subpleural emphysema may be found in the lungs of new-born children.

The *pharynx* should be opened and examined for foreign bodies.

The *larynx* and *trachea* should be examined for the lesions of inflammation and for injuries to the cartilages.

The *thyroid gland* weighs about three drachms. It may be so enlarged as to interfere with respiration.

The Abdomen.—The *kidneys* are lobulated and proportionately larger than in the adult. There may be ecchymoses on their surface, inflammation, deposits of uric acid, deposits of urates in the tubules of the pyramids, cystic dilatation of the tubules, sometimes reaching an enormous size. There may be absence or retarded development of one kidney. Malformations and malpositions of the kidneys are of frequent occurrence.

The *suprarenal capsules* are large. They may be dilated into large cysts filled with blood.

The *spleen* is large and firm. It may be abnormally enlarged, and its surface is sometimes covered with fresh inflammatory exudations.

The Intestines.—In the small intestines inflammation and swelling and pigmentation of the solitary and agminated follicles (lymph nodules) are sometimes found. The large intestine usually contains meconium, but this may be evacuated before or during birth. The sigmoid flexure is not as marked as in the adult.

The formation of gas in the stomach and intestines does not usually take place until respiration is established. If decomposition has commenced, gas may be formed as a part of the process.

The *liver* is of a dark-red color, is large, and contains much blood. Its size diminishes after respiration is established. The size is so variable before and after respiration that it gives little information as to the age of the child. Large extravasations of blood are sometimes found beneath the capsule of the liver without known cause. A variety of pathologic conditions, fatty and waxy degeneration, gummy tumors, etc., may be found.

The *bladder* may be full or empty, both in still-born children and in those who have breathed. Dilatation and hypertrophy may exist during intra-uterine life.

The Generative Organs.—The external generative organs in both males and females are more prominent than in adults. The ovaries are high up in the pelvis and large; the cervix uteri is long; the body small and lax,

leaning forward against the bladder. Phimosis in the male is the normal condition. Malpositions and retarded development of the testicles should be noticed. The *bones*, in suspected cases, should be examined for the lesions of inflammation, rickets, and syphilis.

Wreden's Middle-Ear Test.—Wreden has called the attention of medical jurists to the fact that at birth the cavity of the ear is filled with epithelial cells and fœtal jelly or mucus, which become absorbed within a few hours after the child has been born ; hence their absence may be regarded as evidence of life after the birth of the infant. Cameron states that "Wreden and Schmaltz consider it of importance to determine whether the tympanum and Eustachian tube are airless or not. Presence of air implies respiration, but then more reliable evidence is obtainable elsewhere."

QUESTIONS RELATING TO THE MOTHER IN A CASE OF INFANTICIDE.

According to the same authority (Cameron), the *bacteriological appearances of putrefaction* is the most recent test for distinguishing between live birth, where respiration has been established, and dead birth. "It has been frequently observed that, other things being equal, putrefaction runs a different course in a new-born child that has lived and breathed than in a fœtus that has perished before, during, or immediately after birth without breathing. The micro-organisms are different, attack the organism in a different way, and produce different results. In dead-born children putrefaction begins in those parts of the body which are in contact with the outside air, and is effected by means of the ordinary bacilli found in animal decomposition (bacillus fluorescens, proteus, etc.). In children who have lived and breathed, air enters the stomach and intestines, and putrefaction begins in the intestines ; the active agents belong to the family of the coli bacilli. If these observations are confirmed, a bacteriological examination will afford valuable information which may be decisive in some cases of infanticide." [1]

It is important, in cases of alleged infanticide, for the medical examiner to inspect the reputed mother as well as the child, so as to establish the fact of her having been delivered at about the period of the child's birth. If the case is a recent one, there ought to be no difficulty ; but if the examination be protracted for a week or so, recovery on the part of the woman may have so far progressed that the signs of delivery will be absent, or the woman may have disappeared from her usual abode.

Signs of Delivery.—*Was the woman recently delivered?* If the woman is examined within three days of her delivery, the following signs will be shown : pallor of the face and general weakness will be apparent ; the skin will be moist, relaxed, and soft ; the eyes somewhat sunken, with a

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. ii. p. 182.

dark ring beneath or surrounding them; the pulse will be soft and slightly quickened; and the breasts are knotty to the feel and full and enlarged; the nipples are enlarged, and often exude a watery-like milk. In addition to these signs the abdomen feels soft and relaxed to the touch, and is thrown into folds; it shows on its surface numerous transverse lines, the *lineæ albicantes*. The uterus is readily appreciated between the abdominal walls, being situated low down within the pelvis; it appears like a large ball. The *external genitals* are swollen, moist, and relaxed. The vagina is rather capacious, and there is a muco-purulent discharge from the uterus. The os uteri is patulous and low, the lips thereof being somewhat soft and relaxed, and perhaps lacerated. These signs singly afford no proof of delivery, but when taken together they form conclusive evidence of the recent delivery of the woman.[1] In case the woman had died a short time after her delivery, the signs just referred to would still be present; and, in addition, the uterus would be found to measure from nine to ten inches in length. Furthermore, its cavity would show evidences of the remains of the decidua and the point of attachment of the placenta.

It is well to remember that the lineæ albicantes may follow distention of the abdomen in cases of ascites, etc.; in fact, they have been observed in the male subject.

Examination of the Milk.—It is a fact worthy of remembrance that the milk may be absent; and, again, its secretion has been noticed in the male. If the microscope reveals the presence of *colostrum*, it may be stated that the woman was the subject of recent delivery. Reese says that "the relaxed state of the genitalia and the lochial discharge might be mistaken for the menses, except for the characteristic smell; but the jagged or notched condition of the os uteri and its patulous state are usually to be attributed to a recent delivery." (*Vide* works on Obstetrics for a more detailed account of the signs of recent delivery.)

How long a time has elapsed since labor terminated? In reply to this question Cameron says that "we are enabled to come to a definite conclusion by carefully observing the character of the secretion from the breasts, the appearance and composition of the lochial discharge, the height of the fundus uteri in the abdominal or pelvic cavity, and particularly the freshness of the wounds that may exist in the genital tract."

Concealed Delivery.—This is a misdemeanor in the eye of the law, and renders the woman guilty of it liable to punishment. In cases of infanticide, the object of the mother would naturally be to conceal all traces of her recent delivery, and also the whereabouts of her offspring. Reese says, "According to the statute, the child must be dead; the concealment of a living body is no offence, unless it should happen to die before the birth was made known. In a trial for concealment of birth, the medical evidence is

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[1] The only positive proof of the birth of the child is furnished by the finding of parts of the ovum.

derived exclusively from the mother; the body of the child need not be produced, and the special points which will engage attention are (1) the proofs of recent delivery, (2) the proofs of pregnancy, and (3) the connection between the alleged period of delivery and the state of the child as found."[1]

Can the mother be delivered unconsciously? This question may be raised in cases of infanticide. It might be possible for a woman suffering from the effects of coma, apoplexy, asphyxia, syncope, etc., to be unconscious of the fact of her delivery. Furthermore, spontaneous delivery may occur while the female is dying. Taylor says that "it is in those cases where a female, after her recovery, pleads unconsciousness of her delivery that medical practitioners are chiefly consulted. Hysteria, when accompanied by loss of sense and motion, has been mentioned as a state in which parturition is liable to occur unconsciously. We need not be surprised at a delivery taking place under these circumstances, when we consider that the contractile power of the uterus is altogether independent of volition; but it is difficult to believe, unless the morbid states already mentioned are accompanied by the most profound lethargy and entire loss of sensation, that the contractions of this organ, in its efforts to expel the child, should not suffice at once to rouse the individual into consciousness. We ought to expect this particularly in primiparous females,—*i.e.*, in those who have never borne children. At the same time it must be remembered that parturition with some females, especially when the pelvis is wide and the child small, may take place with such rapidity and ease as scarcely to be accompanied by pain. It has been observed that when a woman has frequently borne children, delivery sometimes takes place without effort and without any consciousness on her part. On other occasions the female may lie in a kind of torpor or stupor and have no recollection of her delivery."

The same authority further states, "There is another condition in which a woman may state that her delivery took place unconsciously; and this, from its being one of the most common species of defence set up by a female charged with child-murder, must here claim our attention. Thus she will allege that, while suffering from pain, she felt a strong desire to relieve her bowels; that she went to the water-closet for that purpose, and was there delivered without knowing anything of the occurrence until it was too late to save the child. This kind of desire is a very constant symptom of the parturient state; and it is often difficult in private practice to restrain a woman from yielding to the feeling, when it certainly would be attended with hazard to the child. We must, therefore, admit that an accident of this kind is quite within the range of probability; but here, as in every other instance in which unconscious delivery is pleaded, the medical witness ought to inform himself of all the particulars which are stated to have attended delivery before he gives an answer specially applicable to the case.

[1] Medical Jurisprudence, p. 543.

As a general rule, it cannot be denied that delivery may take place under these circumstances without the woman being conscious of it; but before we make the admission in regard to any particular instance, we ought to have a full statement of the facts from the female herself. Besides, it has been very properly observed that, after an accident of this kind, a woman cannot be ignorant of her having been delivered. Females who have raised this plea in cases of child-murder have often been known to maintain that they were unconscious of their pregnancy, and thus have attempted to excuse themselves for not having prepared the articles necessary for childbirth. It is possible that a female may not be aware of her pregnancy in the early stage, but it is scarcely credible that she should remain ignorant of it in the latter period of gestation, or up to the time of her delivery. It is at least to be presumed that she must have some reason to suspect her condition; and if only a suspicion existed in the mind of a woman who did not contemplate the destruction of her future offspring, there would assuredly be many circumstances forthcoming which would establish her innocence. If this remark applies to married women, it applies with still greater force to young females, since the fact of illicit connection and the fear of its consequences must render them peculiarly alive to all those changes which, by common repute, take place in the female system during pregnancy."[1]

Signs of Delivery in the Dead.—If a female dies shortly after the delivery of a child, the evidences of that fact are readily ascertained; in fact, the signs of delivery in the living may be discovered in the dead. Just after parturition, on opening the abdomen, the length of the uterus will be found to be from nine to twelve inches; it will also be flat and flaccid, with a widely dilated os uteri. Bloody coagula will be noticed within the cavity of the organ, together with the remnants of the decidua. The placental attachment to the uterine wall may be marked by a gangrenous-looking spot. In those cases where the death of the woman has been somewhat delayed, marked contraction of the uterus, with a considerable modification of the signs just referred to, will be noticed. If a month or so has elapsed, it will be very difficult to determine the delivery; in fact, as difficult as in the living subject. (Reese.)

Feigned Delivery.—(*Vide* Feigned Diseases, etc.)

Tidy furnishes the following outline, which may be of use for reference:

THE EXAMINATION OF THE CHILD AFTER DEATH.

I. The External Examination.—This should embrace the following particulars:

(1) Everything relating to its external appearance, shape, conformation, condition as regards putrefaction, spots, ecchymoses, etc.

(2) Its size: including not merely the length of the body but the dimensions of the head and thorax.

(3) Its weight.

(4) The conditions of the navel and of the umbilical cord.

[1] Medical Jurisprudence, p. 400.

I. *The Internal Examination.*—This should include :

(1) *The condition of the respiratory organs :*
   (*a*) The dimensions and shape of the thorax.
   (*b*) The situation of the diaphragm.
   (*c*) The color, volume, shape, situation, consistency, density, absolute weight, and specific weight of the lungs.

(2) *The condition of the organs of circulation :*
   (*a*) The foramen ovale.
   (*b*) The ductus arteriosus, its dimensions and shape.
   (*c*) The ductus venosus.
   (*d*) The state of the umbilical vessels.
   (*e*) The condition of the heart and its cavities. (This must be noted first.)

(3) *The condition of the abdominal organs :*
   (*a*) The liver, its weight and size.
   (*b*) The stomach and intestines. The presence or absence of medicines, food, air, meconium, etc.
   (*c*) The state of the urinary bladder and kidneys. (Uric acid infarction.)

(4) *The condition of the brain and spinal marrow :*
   The cranium should be examined for fractures, punctures, etc.

CHAPTER XXXVI.

RAPE.

Legal Considerations—Rape on Females after Puberty—Rape on Children and Infants—Rape by Boys—Rape on the Dead—Rape under the Influence of Narcotics, etc.,—Rape on Idiots—Conditions which show that Coitus has occurred—Microscopic Evidence—False Accusations—Actual and Apparent Age—Simulation of Virginity—Can a Woman be violated against her Will?—Can a Woman be violated during Natural Sleep?—Rape by Fraud—The Employment of Hypnotism in forcing Sexual Congress—Examination of the Accused and his Victim—Evidence of Rape after Death—Record of the Medical Examiner.

Rape, from *raptus mulierum*, is, medico-legally, the carnal knowledge of a female forcibly and against her will. Reese says that a more comprehensive definition would be carnal knowledge without her conscious permission, or with such permission extorted by physical violence or fraud.

The legal considerations, as outlined by Chaddock,[1] are as follows: "Rape constitutes an offence in common law, but its legal definition varies in the statutes and codes of various States, particularly with respect to the bearing of the age of consent upon the crime. . . . On the points of 'will' and 'consent' there have been decisions in Arkansas, Florida, Michigan, Nevada, and Wisconsin. Thus, rape may be committed when, in *sensu*

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[1] Hamilton's System of Legal Medicine, vol. ii. p. 525.

strictiori, the woman shows no will at all; as when she is narcotized, or in a state of *non compos mentis*. Carnal knowledge may also be rape where it takes place with consent that has been obtained through fear or fraud. Absence of consent is interpreted as equivalent to being against the will of the woman, in later English law. Rape is possible only in case of physical capacity in the direct male perpetrator; but impotence is no defence for *intent to commit rape* where it cannot be shown that the perpetrator was aware of his sexual incapacity. The age of the male, in its effect upon capacity to commit rape, may be of importance in determining the conditions constituting the crime. A male under the age of fourteen cannot commit rape, according to English law; but in the United States a few courts have held that there is no conclusive presumption of incapacity determined by age. The crime of rape may be perpetrated upon the person of any female, no matter what her age, character, or capacity.

"Since the question of consent is of primary importance in its bearing upon the crime, the age of the female, as affecting her legal capacity to give consent to sexual intercourse, is of the greatest importance. In common law, a child that has not attained the age of ten years is presumed to be incapable of giving consent. Therefore, in general, carnal knowledge of such a child is felony. But statutes in England and in many of the United States make carnal knowledge of a child between the ages of ten and twelve a misdemeanor. If, under such circumstances, the child consents, the offence is a misdemeanor, not an assault. The age of consent in a majority of the States is fourteen years. A New York statute makes it rape for a man to have sexual intercourse with a female to whom he is not married who is under the age of sixteen. It is felony for a man to have carnal knowledge of a child who is under the age of ten in Arkansas, Michigan, Mississippi, North Carolina, and Wisconsin. Intercourse with a child under the age of twelve years is rape under the code of Louisiana. The age of consent is fixed at fifteen years in Nebraska; at thirteen in Iowa; at sixteen in Pennsylvania; at eighteen in Wyoming and Kansas. In Ohio decisions have been less stringent; the knowledge of the child has been taken into consideration.

"Actual carnal knowledge must be shown by direct or indirect evidence in order to establish the crime of rape. Penetration, in the least extent, of the female genitals by the male organ constitutes carnal knowledge. Force, actual or its equivalent, is necessary to the commission of rape; and the force must have been sufficient to accomplish the purpose. Submission obtained by means of fear, or terror induced by threats or otherwise, is construed as the result of moral force equivalent to a compelling degree of physical force. In law, intercourse accomplished by means of fraud, where there was no intent to use violence, is not rape. Within the age of consent, where consent is given, no matter how reluctantly, there can be no rape. The female must have offered all possible resistance, or resistance must have been made impossible by terror or other means. Commonly, connection with a woman

while she is unconscious, as during sleep or insensibility occasioned by alcohol or other narcotics, is rape; and the same is true in cases of idiocy and imbecility, though in New York this is merely a crime against the person.

"The prosecutrix in a trial for rape is a competent witness; but in case the defendant denies guilt, her testimony must be corroborated as to material facts, though the fact of the rape need not be proved by other witnesses."

Rape on Females after Puberty.—*Is the alleged victim a virgin?* In a virgin, as a rule, the following physical signs will be apparent. The *labia majora*, which extend from the mons veneris in front to meet in the fourchette posteriorly, are firm, plump, and lie in contact with one another in the median line, completely covering the lesser lips, or labia minora. The *labia minora* (nymphæ) present a bright rose color. The practice of Onanism may occasion changes in them similar to those caused by excessive sexual indulgences. These folds of muco-cutaneous tissue arise about the middle of the greater folds on their inner aspects, and extend upward, dividing into two portions; the two lower ones joining immediately below the clitoris to form the frænum, and the two upper ones to form the prepuce. "As long as the nymphæ are covered by the labia majora," says Chaddock, "the membrane covering them retains its original characteristics; it is moist and presents a rosy tint. After alteration of the position of the labia majora induces constant exposure of the nymphæ, the mucous membrane covering them undergoes changes which cause it to resemble epidermis. It is less moist, and the rosy hue changes to a distinct brown. This dependence of the condition of the labia minora upon the condition of the labia majora allows no absolute value to attach to the condition of the nymphæ in determining the question of virginity."[1]

The *fourchette* (posterior commissure) is a fold of epidermis formed by the junction of the labia majora at the anterior margin of the perineum. It is rarely affected by sexual congress, although childbirth commonly ruptures it. The *fossa navicularis* is a cavity which is formed between the inferior portion of the hymen and the inner part of the fourchette when the labia are separated. When the parts remain undisturbed, no such hollow exists.

The *vagina* in the virgin is a mucous slit in the pelvic floor which connects the uterus and the vulva; its anterior and posterior walls are normally in contact. Its narrowness and rugose state is a sign of virginity, although this condition has been observed in young married women previous to child-bearing, and even subsequent to confinement taking place at an early age. In this latter instance, however, there will be other signs, such as the changes in the os uteri and perineum. Tidy says that mere sexual congress could hardly change the virginal state of the vagina unless great violence was employed during the intercourse; and, furthermore, a profuse leucorrhœa or dysmenorrhœa may obliterate the rugæ, even of those who have never had connection with a male.

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[1] Op. cit., p. 527.

The *mammæ* are non-pendulous, plump, and elastic. The nipple, which is undeveloped, is situated in the centre of the gland, and is encircled by a pink areola. Frequent manipulation or sexual indulgence has a very slight influence on their elasticity and shape. The integrity of the *perineum* is always found in the virgin state. It is rarely injured in assault.

The *hymen* surrounds the ostium vaginæ. It is composed of mucous membrane on a framework of connective tissue, and may be of several forms. Thus, the hymen may be crescentic, the most usual form, or annular, cribriform, and fimbriated. An imperforate hymen is a pathologic condition. The value of the hymen as a sign of chastity, or of virginity, is slight, as neither is its rupture evidence that sexual congress has occurred, nor its presence an absolute sign to the contrary. Its unruptured condition is, however, in the majority of cases, proof of the female's virginity. Cases are on record where the hymen has been torn or destroyed by accident, disease, or masturbation. Again, its destruction may be effected by surgical interference or during medical inspection. Casper relates an instance where the hymen was destroyed by the child's mother, in her efforts to prepare her for sexual congress with males, by the introduction of the fingers, and subsequently by a stone forced within the vagina.

The *carunculæ myrtiformes* were formerly regarded as remnants of the hymen. They are, however, merely due to the changes brought about during labor, and hence are of no importance in this connection.

Defloration may be complete or incomplete, according as intromission is perfect or imperfect. It is rarely complete in young girls, since penetration by the male organ is seldom or never effected. The question of defloration can be determined only by the presence of the external signs of virginity, of which the hymen furnishes the most positive proofs. This membrane, when ruptured, is never renewed.[1] In *complete, recent defloration* the hymeneal laceration or tear is usually accompanied by hemorrhage, which might be so severe as to cause death, especially in hæmatophilic subjects. The tear is usually stellate in appearance, although it is subject to change in the different forms of the hymen. Edgar and Johnson[2] say that the medical examiner should pay particular attention to the margins of the laceration, which render assistance in determining the date of the attempt. They observe, further, that "these latter are bloody and fresh; later (one or two days) they show slight inflammation; in three or four days suppuration may appear. Healing is usually complete in eight to twelve days, according to Toulmouche; in twenty, according to Tardieu."

Can sexual congress take place, with consent, between young healthy per-

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[1] Vibert states that the tears of the hymen may unite, but such is seldom the case. Tourdes declares that their complete healing, leaving only a trace, is possible.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. ii. p. 434.

ons, without interfering with the intactness of the hymen? A positive answer may be given to this question, since cases are recorded where even fruitful intercourse has occurred without the destruction of this membrane. This anomaly may be ascribed to the presence of a fibrous or fibro-elastic tissue, or to an abnormally tough and resisting membrane. Furthermore, it may be due to the elastic nature of the hymen, or to the great size of its aperture, or, as Tidy states, to the weak virile power of the male.

The other evidences connected with the *external genitals* are: (1) *Swelling and tenderness of the vulva.* The parts will be found more or less congested and hot, so that the patient suffers great inconvenience during locomotion. In some cases the mere separation of the thighs is followed by the most excruciating agony. These two signs are not likely to be simulated. The genitals generally will be similarly affected, and associated with difficult micturition and defecation. (2) *Blood and seminal stains.* These may be discovered upon the genital organs, within the vagina, and upon the clothing of both parties, in case the act has been recent. The hair of the pubes may appear clotted and the linen soiled. It is of importance to ascertain the character of the blood-stains on the clothing both of the ravisher and of his victim. Tidy[1] says, "The first blood that would flow from the genitals of a female that had been violated would probably be unmixed with mucus and of a uniformly red color; but stains resulting from the blood discharged at a later period would be more or less non-uniform and of a dirty color, from admixture with the vaginal discharge. It can scarcely be argued that blood-stains on clothes are *per se* of much value in establishing a charge of rape; nor, on the other hand, that their absence can be regarded as of much importance as proof of innocence." Furthermore, the blood-stains on the female's clothes may be menstrual. It is important for the medical jurist to remember that the clothing of a woman may be intentionally besmeared with blood in cases of false accusation. The evidence to be derived from an examination of seminal stains[2] may be of great importance. These stains

[1] Op. cit., vol. iii. p. 133.

[2] *Semen* is a viscous and opaline fluid, possessing a peculiar smell and slight alkaline reaction. It contains about fifteen per cent. of solids and eighty-five per cent. of water. The solids are composed of albuminous principles, extractive matters, and a small portion of fat and salts. Under the microscope (three hundred to four hundred diameters) the *spermatozoa* are observed. These bodies are characteristic, being very minute, their length often not exceeding the one-six-thousandth of an inch. In the human specimen the head is almost oval and flattened. The tail is long and slender, measuring about five or six times the length of the head, which is about one-nine-thousandth of an inch in diameter. The spermatozoa, when living, exhibit an undulating motion, which is chiefly performed by means of the tail. The seminal fluid is also possessed of bodies termed seminal granules, and also epithelial scales and mucus-corpuscles. A seminal stain is rather stiff and without color, but by transmitted light a grayish-brown tint is noticeable. When subjected to heat it assumes a pale yellow color. The peculiar and characteristic smell of semen is evolved when it is moistened or warmed with warm water. The following method, after Tidy, may

may be discovered either upon the clothing of the female or upon that of the male, or upon the clothing of both. Their presence indicates the consummation of the sexual act. Tidy says, "The value to be attached to such stains must not be over-regarded, seeing that if they be found on the female they in no respect fix the crime on any one particular individual, while if they be found on the male they may result from spermatorrhœa or other causes. Again, if seminal stains be absent, it must be remembered that a legal rape may be committed, and yet be unaccompanied by the emission of semen, while subsequent washing may remove whatever stains previously existed,—a circumstance, however, which of itself may constitute important evidence, and should be recorded." Spermatozoa, according to Müller, retain their motile power in the vagina for a period of eight days. Bayard says that he has discovered them alive three days after sexual intercourse, and in stains after six years.[1]

Incomplete, Recent Defloration (*vide* Rape on Children and Infants).—In *non-recent defloration* the hymen is only indicated by its remnants. The

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be adopted for the examination of suspected stains. (1) Digest a portion of the fabric (or scrapings) in a watch-glass with a few drops of water for about ten minutes. Remove the fabric, and carefully squeeze out with the fingers the water absorbed. Place the glass in a good light on a piece of white paper, and add to the solution a drop of nitric acid on a glass rod. If the stain be seminal, the liquid will turn of a yellow color, but there will be no precipitate. (2) Lassaigne suggests that, in order to distinguish between an albuminous and a seminal, stain, it should be moistened with a solution of lead oxide in liquor potassæ, and dried at 20° C. (68° F.). If it be albuminous (that is, if it contains sulphur), it turns of a yellow color; but if it be seminal, no change will be apparent, unless, as sometimes happens, the semen be diluted with an albuminous secretion. If the clothing upon which the stains are discovered be very much soiled or colored, these tests are valueless. The *microscopic test* is the only positive proof. The suspected stain should be cut out of the clothing, placed in a clean watch-glass, and treated with distilled water. After it has been soaked sufficiently, it should be squeezed, so as to remove the water. Specimens of the liquid are next placed, by means of a glass rod, on a glass slide, under the microscope. The characteristic appearances of the spermatozoa have already been noticed. (*Vide ante.*) When dead, these minute bodies are readily detected by their shape. They possess a remarkable power of being proof against decomposition, having been found in putrid semen. Weak acids arrest the movements of live spermatozoa, while alkalies stimulate them. Seminal spermatozoa have been confounded with minute fragments of the fibre of linen and granules. The former might readily be mistaken for the tails, and the latter for the heads, of the animalcules. According to Tidy, "Admit nothing to be seminal unless some complete spermatozoa can be detected."

The animalcule known as *trichomonas vaginæ*, and discovered by Donné in the vaginal mucus of persons who are unclean, might be mistaken for seminal animalcules. The differences between the two are thus described by Semple. "The heads of the trichomonads are three times larger than those of the spermatozoa. The trichomonad internally is granular, while the heads of the spermatozoa are structureless and transparent. The boundary wall at the head of the trichomonad contains several cilia, but none such are found in spermatozoa."

[1] Edgar and Johnson, op. cit.

ostium vaginæ is usually dilated and patulous, the same condition being perceptible in the canal itself. The margins of the tears of the hymen are generally smooth and rounded. The vulva may also be considerably dilated. Furthermore, in females accustomed to sexual congress, bleeding is not necessarily a result of even forced connection, unless the violence be excessive. On the other hand, there may be considerable hemorrhage even from superficial wounds or injuries, although nothing more than vulvar penetration has been effected. The signs of repeated indulgence in sexual congress, as outlined by Edgar and Johnson,[1] are: "an open, enlarged state of the vulvar canal, with separation of the labia majora and loss of their plumpness; a lengthening of the nymphæ and change in their pink tint to a yellow r light brown, combined with a general flaccidity of the organs." These anges are not, however, uniform in all cases, for it is possible for the genls to retain their virginal state for years after sexual indulgence. (*Vide* nditions which furnish Evidence that Coitus has occurred.)

Rape on Children and Infants.—This crime is far more common n that on adult females, on account of the feebleness of resistance and innocence and ignorance of these subjects. Tardieu observes that of a l of twenty-two thousand and seventeen cases of rape in France, between years 1841 to 1875, seventeen thousand six hundred and fifty-seven were children. The ages of children, as observed by Casper in one hundred nine cases, were as follows: seventy-eight of these cases were from and a half to twelve years old, seventeen from twelve to fourteen years, en from fifteen to eighteen years, and seven from nineteen to twenty-five rs,—over seventy-five per cent. of the cases being below the age of lve years.

As stated before, complete defloration of young girls is a rarity, on acunt of the extreme difficulty of effecting penetration by the male organ. is is very likely due to the deep situation of the hymeneal fold and the rrowness of the external vulvar orifices. (Fredet.) In most all of these ses of rape the genital organs will exhibit evidences of injury, especially the act has been completed and resistance was made. Such injuries are ceration of the pudendum and adjoining parts. There will also be extravation of blood. If the inspection by the medical man be made within a w days (two or three) after the assault, the following signs will be apparnt: tumefaction and inflammation of the external genitals, with partial brasion of the mucous lining; a muco-purulent discharge, of a yellowish or reenish-yellow tint, from the vaginal canal; it possesses a ropy consistence, nd stains and stiffens the victim's underclothing; urination is extremely ifficult as well as painful, due to the extension of the inflammation to the urethral canal; the abraded membrane exudes a bloody fluid, and clots of lood are found in the vulvar orifice. The hymen is in most instances uninjured, but it may be either destroyed or greatly lacerated. In very young

[1] Op. cit., p. 436.

children an inspection of the external genitals will often fail to detect the situation of the hymen, as it is frequently placed very far back in the vulva. In such cases it is not often lacerated by the male organ. Out of one hundred and eighteen cases of rape on children, Tardieu states that he discovered tears of the hymen eleven times in children of eleven years of age, once in a girl of nine, and once at six years. In fifty-four cases mentioned by Casper, many of them being on children under fourteen years of age, the hymen was intact in fully four-fifths of the number. These cases were complicated with syphilis.

If penetration has been effected, there may be marks of serious injuries. Unnatural dilatation of the vagina has been referred to. The fourchette or posterior commissure may also be affected, and in some cases, where unusual violence has been employed, destruction of the perineum may follow. Other signs to be observed in these cases (incomplete defloration) are pain and difficulty in walking, together with the inflammatory symptoms described as occurring in adults.

Marks of violence on the external genitals in children under twelve years of age are rare, because any resistance that might be made is usually very slight. If, however, the child has approached or passed the age of thirteen years, resistance to an assault attempted upon her person would undoubtedly be made ; hence the presence of marks of violence beyond the genitals would be discernible.

The existence of a discharge from the vagina is frequently adduced as a sign of rape in young children. Upon examination, parents frequently look upon this condition as evidence of rape, and very often will place the blame upon an innocent person. Infantile leucorrhœa is a most common affection, being very prevalent in children under seven years of age. It most commonly results from an inflammation of the vagina, but dentition and local causes of irritation often produce it. This discharge may be distinguished from that due to defloration by its chronic state and by the absence of injury to the genital apparatus. Besides this, the inflammatory condition of the mucous membrane and the character of the discharge will render the differences plain. Furthermore, the flow is much greater than that occurring as the result of injury. (*Vide* False Accusations.) The clinical characters of simple catarrh due to vaginitis or endometritis may be confounded with gonorrhœa. There ought not to be any difficulty, however, in distinguishing between the two affections. The microscope reveals the presence of vaginal epithelium, leucocytes, and bacteria in rods, single cocci, and diplococci, while gonococci are readily perceived if gonorrhœa really be present in the child. It should be remembered, in this connection, that gonorrhœa and even syphilis may be communicated to young children by other means than by sexual contact. Such instances are, however, of rare occurrence. *Noma pudendi* is of more rare occurrence than infantile leucorrhœa. It frequently occurs as a sequel to the typhoid state, and may prevail in an epidemic form. The discharge arising there-

from may also be the ground of complaint against an innocent man for a felonious assault. In all of these cases where false accusations of rape on children are brought by parents or other ignorant persons, it would be well for the physician to examine the accuser and the child separately and apart.

Rape on young children often results in such serious injuries—as laceration of the vagina and perineum, with their sequelæ—as to result in death.

Rape by Boys.—Boys not infrequently commit rape on young female children, and it may be proper to remark here that connection in children is often possible at very tender ages. Boys of four years are sometimes capable of having an erection of the penis, and, according to Lombroso,[1] the sexual instinct manifests itself peculiarly early in children possessing a hereditary neurotic taint. Gonorrhœa has been acquired by young boys from aving sexual congress with very young girls. Koplik mentions an instance which gonorrhœa was contracted by two boys, five and nine years of age, y sexual intercourse with a girl of seven years.

The age at which intromission is possible differs according to various riters. Thus, Toulmouche and Tardieu state that penetration may be complished at the ages of fifteen and ten respectively. It is, however, npossible for intromission to be perfect at the age of ten years, although ceptional cases are on record of its having been complete.

Rape on the Dead.—This revolting crime is a very ancient one, having een, according to Maschka, practised by Egyptian embalmers during the me of the Pharaohs. In the State of New York the crime is provided for y a maximum penalty of twenty years' confinement in State's prison. This aw was the outcome of an attempted rape upon a dead body in the New York City morgue.

To determine whether the person of a woman, found dead, had been ravished before or after death is a rather difficult matter, because there will be no statement from the prosecutrix herself. Taylor says "that the witness can seldom more than express a conjectural opinion from the discovery of marks of violence on the person and about the genitals. Even if spermatozoa were detected in the liquid of the vagina, or on the dress of the female, this would merely prove that there had been intercourse; whether violent or not must depend on circumstantial evidence."

Rape under the Influence of Narcotics, etc.—(*Vide* legal considerations in this connection.) The possibility of a female being violated unknowingly, while under the influence of narcotics, may be admitted; but such cases must be regarded with suspicion. The same holds true with respect to the unconsciousness produced by alcohol and anæsthetics. Chloral hydrate, tobacco, opium and its alkaloids, ether, chloroform, etc., are the drugs usually employed in these cases. The induction of instantaneous insensibility by the administration of narcotics is scarcely a possibility, since these substances are of slow action; furthermore, they are

[1] Archiv. di Psichiatria, vol. iv.

usually followed by vomiting, a condition which would excite immediate suspicion. Women under the influence of nitrous oxide gas, chloroform, ether, and while intoxicated have been ravished; but it is well, in this connection, to recollect that females who are emotional while under the influence of these substances, especially if the period be that of their menses, may imagine that they are having sexual relations with their husbands, or even with the medical man who may be prosecuting his duties as a surgeon at the time. Physicians have been charged by such females with the commission of rape, and, although perfectly innocent of the crime, have suffered conviction and confinement in prison. Dubois mentions the case of a female undergoing an operation, who, while under the influence of the anæsthetic, attempted to caress her attendant by drawing him close to her side. After the effects of the anæsthetic had passed away she confessed to having dreamed of sexual congress with her husband while unconscious. Hence it is important to exercise extreme caution in accepting the testimony furnished by the prosecutrix, unless a medical examination corroborates her statement. (*Vide* Rape during Sleep, etc.)

Rape on Idiots, Epileptics, etc.—Carnal intercourse with an idiot is rape. "In such a case resistance and force may have been in play," observes Chaddock,[1] "as in any other; but, under such circumstances, ordinarily the question of the crime hangs upon the irresponsibility of the female for the assent she may have accorded. The proof of the mental condition of the prosecutrix then becomes indispensable, and this must follow on general psychiatrical lines. At the same time, in case consent has been given by an irresponsible female, it would also be obligatory on the part of the prosecution to show that the accused was aware of the irresponsibility of the female, in order to bring the crime within the legal definition of rape." A charge of rape may be brought by a female who asserts that she was violated while suffering from an *hysterical* or *epileptic fit*. Such charges must always be received with suspicion. It is difficult to establish a charge of rape under these circumstances. Other states of temporary insensibility rarely present a time favorable for the commission of the act.

Conditions which show that Coitus has occurred.—(*Vide ante.*) In this connection it is important for the legal physician to keep fresh in mind the appearances of the female genitals in their virginal state, in order to be the better able to appreciate those changes of conformation which are apt to occur subsequent to the first coitus. The appearances of the virginal genitals have been described in a previous paragraph, as have also the effects thereon of sexual intercourse with the male. To recapitulate: the physical signs of rape in the grown female may be tearing of the hymen and fourchette, the presence of blood upon the affected parts and clothing of the victim, evidences of a struggle, injury of the genitals and of other parts besides the hymen, the presence of semen in or about the genitals or

[1] Op. cit.

n the pubic hair, the state of the vaginal walls, the existence of venereal lisease, etc. In children the signs are of longer duration than in grown emales. Hemorrhage may be found wanting in rape on children, although the parts may appear bruised.

It is important to remember that the existence of venereal diseases n women is by no means absolute proof of impure sexual congress, since hese affections are frequently the result of causes other than genital. Re-arding the state of the vaginal wall and its mucous membrane in adult males, aside from great injury, no evidence can be derived therefrom as to hether primary coitus has or has not occurred. In young children, however, e case is different. Here the vagina is narrow, so that, if sexual congress effected, it is capable of showing signs of having been dilated. Habitual tion, on the other hand, produces characteristic alterations of the vaginal nal; its rugosity is lost, together with the primitive delicacy of structure its mucous membrane, and the muscles and tissues about the introitus ginæ become relaxed. (Chaddock.)

Microscopic Evidence.—This form of evidence is not requisite to proof of rape on the living, since *emissio seminis* is not essential to this me, the law merely demanding the proof of sexual contact. Rape may committed, in the legal sense, without reference to the emission of sper-tic fluid. Are stains of this description, if found on the clothing of a spected person, capable of furnishing undeniable proof of the legal con-mmation of the act? Taylor says, in reply to this query, that "without rroborative proofs from the state of the female organs they cannot be so ken, and, therefore, the affirmative evidence from the microscope, under ese circumstances, is as liable to lead to error as that which is purely nega-ve. The fact that spermatic stains are found on the linen of the prose-trix may, however, become occasionally of great importance in charges f assault."

False Accusations.—According to Amos, false accusations are as fre-uent as twelve to one of true charges. Grown females often accuse inno-ent men, particularly physicians and dentists, of having abused them while nconscious from the effects of an anæsthetic or other drug. The greatest aution should be exercised before accepting such accusations. In such ases the statements usually made are the result of illusions during the un-onsciousness of the subject. The prosecutrix most frequently claims that he was but partially under the influence of the drug administered, or, in ther words, unconsciousness was not complete; and while in this con-lition she had not the strength to offer resistance to the assault. Such vidence should be received with very great suspicion, and something nore required to establish a charge of rape. The medical examiner hould be extremely careful in accepting such statements unless they be orroborated by proper medical inspection. When the charge is made by prostitute or other female of shady reputation, this fact alone should e sufficient to reject it as unworthy of further consideration. In almost

all instances of rape upon grown females the truth or falsity of the charge depends upon whether or not consent has been previously given. One of the most sensational trials, in this connection, for assaulting a young woman occurred in New York City, November, 1895. The defendant was convicted by a jury, before the Recorder, of assaulting the plaintiff. When arraigned for sentence, on December 2, 1895, the defendant was discharged by the Recorder on the confession of the woman, who admitted herself a perjurer. So remarkable was the judge's address to the prisoner at the bar for sentence that the writer reproduces it in its entirety. An excerpt from the woman's confession is also subjoined. The Recorder, addressing the prisoner, said, "Upon a careful review of the testimony given upon your trial, it must be clear to any impartial mind that the jury were absolutely warranted and justified in finding against you the verdict they found. Even upon the testimony of the girl herself, if there could have arisen a reasonable doubt, you dispelled that doubt yourself,—you and some of your witnesses; you particularly. Your own testimony dispelled any doubt that could possibly arise upon this record as to your guilt. Your refusal to answer questions on the ground that they would incriminate or degrade or disgrace you, your palpable exaggeration, your statement of occurrences which to the mind of any man manifestly were false, your statement of occurrences there were such as could scarcely in human reason be believed of the most abandoned woman. Had you confined yourself to the truth, even though you may have contended—and you may from your stand-point have believed yourself justly contending—that you obtained the girl's consent, had you confined yourself to that, the jury might have acted and thought differently. But you did not confine yourself to that. You went beyond that, and you testified to a series of occurrences which upon their face carried with them their own refutation because of their exaggeration and absolute improbability. And then, again, what contributed most to your conviction was your evil repute. Had you been a man of good character, could have shown good character, and whose reputation was fair and good and upright and honest as a man, you might never have had the verdict of guilty rendered against you which you have. It is only an illustration of how valuable a good character is in time of need and in the hour of peril. And I am satisfied that your evil repute, probably more than anything, placed you in the position you are.

"Since the rendition of the verdict I have, as the law gives me authority to do, inquired as to circumstances that would tend to mitigate your punishment, as well as to circumstances that would tend to aggravate your offence. Those are the words of the statute. I have received a great many communications, both for and against you. The peculiar character of these communications is that those speaking in your favor have, without an exception, been anonymous, and some of them very scurrilous. Those against you have been signed by reputable men and women who have offered to come forward and make affidavit—and some of them have done so—of

former transactions of yours, when nothing but the modesty of the woman prevented your being arraigned at the criminal bar then; and your life, it will appear, has been one not of loose morals, because this court is not going to be a censor of morals, but of unbridled lust, committed by violence, and you have even kept a diary as to the acts of your successful transactions. The wonder is you have escaped from being arraigned at the criminal bar so long. You may bear now upon your person marks of violence inflicted upon you by women in defence of their honor, and you have been found with your face covered with blood in a certain well-known house in this city. Your record is a very unsavory one. But notwithstanding that, no matter what you have been and no matter what you may be, you are entitled to strict justice, and that justice demands that you be not punished under this verdict.

"I have since the verdict was pronounced instituted upon my own responsibility, actuated by some motive or at least by some spirit that I cannot account for, conducted an investigation into this matter, and the result of my investigation is, I am fairly and reasonably convinced,—that is, as far as human testimony is concerned, and keeping in mind its fallibility, I am convinced that you are innocent of this crime.

"This girl has confessed to me that she consented to the act with you. During many long hours of anxiety and perplexity I must say, covering the days and nights since your conviction, I have struggled with this case, and I trust that during the rest of my judicial life nothing of the kind will ever present itself to me again.

"Strictly speaking, there might be a grave question whether or not I should arrest judgment; whether I should permit a solemn verdict of a jury to be challenged; and were the crime of a different nature than it is, I should have grave doubts and hesitancy as to whether I would allow a verdict of a jury to be thus challenged. But considering the peculiar character of the crime against you, and all the surrounding circumstances, I am satisfied that even without the light of judicial precedent upon this matter,—and I doubt if there has occurred a case in the history of criminal jurisprudence in this or any other country to equal this,—and without the light of precedent or judicial opinion to guide me, I have had simply to rely upon what I consider to be the principles of right and justice, and to exercise that inherent power that a court has in its own records, over its own transactions.

"I have obtained from this girl, after many conversations with her, after exhaustive questioning and examination, a full confession. In justice to the unfortunate creature, she yet persists in denying the frightful and repulsive accusations which you have made against her on the witness stand, and which I before referred to as carrying with them their own refutation.

"I have urged her, and I think that she has recognized the fact, and she says so in her confession here, that she has done a grievous wrong, and that she is willing to undo that wrong now. She has suffered—the unfortunate

girl—very much, and what with her sufferings of conscience and her homeless, houseless, and friendless condition, her lot is indeed a sad one.

"I have no word to say as to your act in taking advantage of her visit to your chambers that morning, so long as she says that she consented to your advances. A court of law has no right to pass an opinion, or to express an opinion one way or the other as to the generosity of your conduct, but she does state in her confession that it was your cruel and cold-hearted treatment of her when she went back to you a second time and told you that she feared she would become a mother, and fearing she would become a mother, knowing she had no home, no friends, and that she was, practically speaking, destitute, that as soon as her unhappy condition would become apparent she would be cast out on the streets as a foul and unclean thing, that impelled her to make the charge. And when she told you of her condition she says you sneered at her and you treated it lightly; you told her she need not be troubled, that she now had a way of making a living much better than by book-canvassing. She absolutely denies your assertion that she again submitted to you on the second visit.

"I will not read this confession. It is very thorough. She goes into everything that occurred; but, to sum it up, she says that the going from house to house and from place to place and from person to person, looking for a sympathetic friend and not finding any, that finally, when she visited the lady to whom she made her first complaint, that she then thought, having been rebuked and having failed to see other persons she sought, she then had the thought in her mind of going to the doctor. The latter told her that he could not tell whether she would become a mother or not; and yet the thought in her mind was so maddening to her that she was afraid, by reason of the nature of the conversation she had had with you, she saw nothing before her but a life of shame and degradation; and in order to protect herself somewhat she told Miss Smedley that you had outraged her, and Miss Smedley, acting on the feelings of an indignant, virtuous woman, and a good woman, immediately caused complaint to be made by bringing her to the police court, and once there the girl had not the strength of character to recede one step from the position which she had taken; and even after that, and in the police court, the girl states in her confession that she wished to withdraw without giving any reason, that she wished to discontinue the prosecution without stating her reason, but that her friend would not permit her to do so, inasmuch as her home was involved; and the girl goes on to say, then, that if she had withdrawn she would have been cast out by these friends and looked upon as a liar and an abandoned woman, either one or the other. And she says, in her own pathetic language, 'What was easy at first became easier as the case went on, and the story I told at the commencement became to me as if it were true.' So that poor unfortunate one lied, and she sat here on the witness stand for five hours, undergoing a most excruciating examination at the hands of your counsel; and I venture to say it is not usual, at least, to find a female wit-

ness withstanding so successfully all attempts made to cast a blemish upon her reputation and find a flaw in her life as that poor girl did.

"I may be permitted here to say that it is the experience of all lawyers that it is a very unwise thing for counsel to cross-examine a young woman unless they have the proofs of her guilt so conclusive that she cannot get way from them ; and your counsel for five hours plied this girl with ques-ons, making her his own witness, and her answers became conclusive upon m, and during those five hours she withstood that attack successfully. I ve considered as to what course to take. I will read just a paragraph her confession. 'I know that —— was convicted of assault, as I have rged, and that he is now awaiting sentence on that conviction. I make s sworn statement of my own free will without persuasion or urging from person whatever, but solely from a desire to do justice, and even at this day to undo the wrong which I have already done, as far as lies in my rer. Before making this statement I have been cautioned by his honor, Recorder, that I need make no statement whatever which might inculpate or hereafter be used against me in any way or for any purpose ; but that make such statement it must be of my own free will and expression. I make this statement of my own free will and expression, and with the wledge that it may inculpate me or be used against me in any proceed-s hereafter which the ends of justice may require, and I am willing to be ished for the wrong that I have done.' Then she goes on to recite in unhappy narrative her unfortunate life.

"Under the condition of affairs, while a formal motion has not been le, but exercising the inherent power of this court on account of this st extraordinary situation, justice dictates to me to do one thing, and one thing, and that is to set aside this verdict and grant you a new l. I shall not commit you to prison, holding you for a new trial, because manifest that on a new trial, with this testimony in my possession, or at t in the possession of the court, and of the law officer of the court, you ld not be convicted. But in order that the ends of justice may not be trated, as far as this case is concerned, I will commit you to the House Detention as a witness awaiting such action as the district attorney of this nty may think proper to take. He may see fit and he may find it neces-to use you as a witness in proceedings hereafter growing out of this ortunate case. I will, therefore, discharge you upon your own recogni-ce, under this indictment, and grant you a new trial for the reasons set h ; but I will commit you to the House of Detention as a necessary and ortant witness to be used in the discretion of the prosecutor of this nty. I will consult with the district attorney as to the amount of bail I fix for your attendance as a witness, but until such bail be fixed, you are anded to prison."

False accusations based upon disease of the genitals in children, or upon ease artificially induced for purposes of extortion or black-mail, have n mentioned before (*vide ante*). "When the action is designedly false,

examination generally shows an intensely inflamed vulva, attended by difficulty of movement and pain on micturition, the result of the maladroitness of the simulator. Its very intensity is evidence against its genuineness, but there is not a single differential sign to distinguish between the two. On October 26, 1880, Professor Fournier presented before the Paris Academy of Medicine a child, aged eight, said to be the victim of an assault. The vulva was violently inflamed, the labia swollen and eroded. All the parts were very red and tender, and covered with thick, greenish pus. The hymen was intact and the inguinal glands on either side were swollen. She was cured in two weeks. She confessed, after a time, that the condition was caused by friction with a blacking-brush. The discharge might, of course, have been distinguished from gonorrhœa, but there was nothing to aid in separating it from the discharge produced by defloration. Its intensity alone awoke suspicion."[1]

Actual and Apparent Age.—If the female be under age, and she consents to sexual congress, rape is committed, since the consent does not excuse the act under these circumstances. If, however, the age of consent be nigh (fourteen years), the crime might be subject to mitigation; and, furthermore, should the child exhibit a premature development, giving her the appearance of being much older than she really is (she being in fact under the age of consent), her having connection with a male ignorant of her real age, under such particulars, and with her consent or invitation, would render the case similar to one of the age which she appears. The law of Austria considers such a one. (Chaddock.)

Simulation of Virginity.—The signs of virginity, collectively, are possibly evidence of the female's preserved chastity. If taken singly, however, absolute proof that she has not indulged in sexual congress is found lacking. Simulation of virginity, for several reasons, is frequently attempted, and in some instances with remarkable success. By the employment of astringents, contractility of the vaginal walls and restoration of the hymeneal membrane may be effected to a certain extent. Sponges saturated with blood are placed within the vagina so as to simulate the hemorrhage that usually follows first coitus. The pain is easily feigned. During pregnancy the changes occurring in the mammæ cannot be feigned.

Can a woman be violated against her will? This question frequently arises in courts of justice. It depends for its solution upon the relative strength of the woman and man under consideration. If a healthy and vigorous adult female makes a determined and strong resistance to the lustful advances of a man, there can be no possible doubt as to her ability to thwart his desire, if contrary to her will. On the other hand, her strength will prove of little assistance if there be more than one assailant; and, again, she may be overpowered and compelled to yield through fear of her life or under duress. In other cases the woman is drugged (*vide* also Rape by

[1] Edgar and Johnson, op. cit., vol. ii. p. 474.

]). Casper mentions an instance in which a healthy and vigorous woman :nty-five years was overpowered and raped by a single adult male. The of the medical man in these cases is to ascertain whether or not, so far : examination elicited, sexual congress was effected. The question of nust be left for the jury to decide. Edgar and Johnson[1] say, "When light traces of a struggle are found on the thighs and breasts, it cannot irmed that the plaintiff has used all her strength in her defence, if she ng and healthy; for a certain class of women, willing enough in point t, make a point of a show of resistance before yielding; and, on the hand, light pressure on those parts of the female form is sufficient to nine an ecchymosis."

in a woman be violated during natural sleep? Tidy states he violation of women during sleep is possible only in the case of habituated to sexual congress, or in the married. It is improbable gins; although it might be possible for a man to rape such a person : unnatural somnolence or catalepsy. "The Scottish judges recently d that it was possible for a man to have connection with a woman she was asleep, but that this could not be called rape in the indictment, that no force was used to overcome her will![2] And here a curious on may arise. Suppose the case of a man getting into bed with a :d woman who is asleep at the time, but who rouses just sufficiently to that somebody is getting into her bed. Suppose, further, that in this onscious, semi-awake condition, the room at the time being dark, and aturally believing the person to be her husband, submits to his em- ,—Is this consent? This was the case of R. *vs.* Young (14 Cox, 114). a married woman was asleep in bed with her husband, the prisoner to bed and proceeded to have connection with her. When she awoke first thought it was her husband, but on hearing the prisoner speak, eeing her husband at her side, she flung the prisoner off and called out husband. Upon this the prisoner ran away. The Court for Crown Reserved were unanimously of opinion that the case was one of rape. vorthy of remark that in this case the woman had gone to bed 'par- under the influence of drink.' In R. *vs.* Mayers (12 Cox, 311), Lush, us stated the law to the jury: 'If a man gets into bed with a woman she is asleep, and he has connection with her, he is guilty of rape.' : cases of R. *vs.* Saunders (8 C. & P. 265) and R. *vs.* Williams (8 C. 286), it was decided that if a person gets into the bed of a married n and by the fraud of making believe to be her husband has connection ier consent, this is not rape. In the case, however, of R. *vs.* Barrow . 1, C. C. R. 156), a woman while in bed with her husband permitted risoner, under the belief that he was her husband, to have connection

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[1] Op. cit., p. 448.

[2] Case of Sweenie. Irvine's Justiciary Reports, vol. iii. p. 109; and Edinburgh ily Journal, December, 1862, p. 570.

with her. It was held that, in the absence of proof that she was aslee unconscious at the time, it must be taken that her consent was obtaine fraud, and that the prisoner's act, therefore, did not amount to rape. tain of our judges, however,—viz., Kelly, C. B., Mellor, J., Denman, Field, J., and Huddleston, B.,—doubt whether this case was rightly deci not admitting the principle that 'where consent is obtained by fraud the does not amount to rape.' As a fact, this has always been a doubtful pc more especially when it occurs under the above-mentioned circumstan Thus, in the case of R. *vs.* J. Jackson (Russ and Ryan, 487), four juc thought that the carnal knowledge of a woman while she was under the b of its being her husband would be a rape, but eight other judges thoug would not. Dallas, C. J., pointed out forcibly the difference between c pelling a woman against her will, when the abhorrence which would natur arise in her mind was called into action, and beguiling her into consent co-operation ; but several of the eight judges intimated that if the case sh occur again, they would advise the jury to find a special verdict." [1]

Rape by Fraud.—This phase of the crime of rape has been alre partially alluded to in the last paragraph. The most common fraud, in connection, next to that of the ravisher passing himself off as the victi husband, is the medical. Innumerable instances are mentioned in the bo of physicians outraging their patients after convincing them that the sex connection was necessarily an important part of the treatment for which t consulted him. A doctor was found guilty of rape upon a young girl, having been led to believe that it was part of her treatment, and that was receiving an injection. (Reg. *vs.* Stanton.) Other cases of a sim nature, too numerous for quotation, are recorded.

The Employment of Hypnotism in forcing Sexual Congress The resistance offered by a female to sexual approach might be preven by this means. "A trial for rape was held in the Rouen Assizes (187 known and celebrated in French annals as the case of Bertha B. and dentist Levy. Brouardel was called in to examine the girl, and made exhaustive report. She presented symptoms of hysteria, anæsthesia of genitals, etc., and the hypnotic condition could be easily produced in The decision of the medical examiners was that the state of nervous s really existed, and that a girl might be violated while her will is abolis by this means. The young woman was raped in the dentist's chair horizontal position, according to his own confession ; but he claimed, at same time, that she was a willing party. This she vehemently denied, ing that the defendant had rubbed her gums with some substance, and in a few minutes she passed into a deep sleep. When she recovered sciousness she felt pain in her genitals, and there were blood-stains on thighs. Her mother remained in the room during the whole time, and not interfere, although she must have heard her daughter cry out. I

[1] Tidy's Legal Medicine, vol. iii. p. 118.

convicted, largely upon his own avowal of guilt. It is possible, of e, that the intercourse took place with the girl's consent; but as the otic state is capable of producing perfect insensibility of all kinds, there reason to suppose, as Taylor suggests, that she would have been ed by the pain. This view is confirmed by Devergie in a case in which as the expert. The element of doubt is, however, much stronger in ast. A girl of eighteen, after visiting a therapeutic hypnotizer daily me little time, found herself shortly pregnant, and lodged a complaint st the man. On examination, her pregnancy dated back four and one- nonths, to the time of her visits, and the possibility of the occurrence e stated it was recognized. No mention seems to be made of the fact impregnation might have been the result of intercourse between visits." [1]

Examination of the Accused and his Victim.—In the case of an ed rape the duty of the medical witness is a very simple one. First of e should make accurate note of the precise time of the medical in- ion, this being an important feature sometimes enabling the defence monstrate that the supposed victim did not avail herself of the first op- inity to make complaint. Furthermore, the time of the perpetration e alleged offence should be recorded, another important point for the ner, to enable him to prove an *alibi*.

he following outline, after Tidy, will greatly assist the examiner in his :

Examination of the Accused.

e.—(1) His size, strength, and general development, in comparison with those of the accuser. Is he impotent or not?

(2) Marks of scratches, etc., on the face, hands, penis, and body generally.

(3) The condition of the frænum, the presence of seminal fluid in the urethra, and of the smegma around the glans,[2] etc.

(4) Rents in, or stains of blood, semen, mud, etc., on, the clothes.

(5) Whether the marks on the accused correspond or not with those on the accuser.

(6) Whether the stains of mud or dirt, etc., on the clothes or boots of the accused correspond or not with what might have resulted from a struggle at the spot indicated by the accuser as that where the alleged crime was committed.

(7) Whether the accused be suffering from gonorrhœa or syphilis. If he is not and the accuser is, or if he is and his accuser is not, such evidence is most important.

Examination of the Accuser.

Record:

(1) The date and hour when the female first made complaint, and the precise words employed by her at the time.

(2) The persons by whom she was accompanied.

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[1] Edgar and Johnson, op. cit., p. 453.

[2] During a trial for rape in England, the physician who inspected both the accused the accuser stated in his written report, "On pushing back the foreskin of the s of the accused, there was an odor perceptible peculiar to woman."

(3) The general behavior of the female. Whether her statements were apparently made under compulsion, or were in any measure dictated by those accompanying her.

(4) The general feeling of those accompanying the female (*a*) toward herself and (*b*) toward the accused.

(5) Any further remarks made by the female or her friends.

(*Note.*—If the medical jurist be directed to visit the female for purposes of examination, it is advisable that he should not give notice of the precise time of his intended visit, in order to avoid preparations being made for it.)

II. Inquire:

(1) The age of the female.

(2) The date and exact time when the rape was said to have been committed.

(3) The place where it occurred.

(4) Whether she uttered any cries, or was too terrified to do so.

(5) The exact circumstances under which the rape was committed (as, for example, whether the parties were standing or lying on the ground, etc.).

(6) Whether or not the female was menstruating at the time.

(7) Whether she was sensible during the whole time that the offence was being committed.

(*Note.*—Avoid all leading questions, more especially in the case of children.)

III. Note:

(1) Whether the female exhibits any signs of narcotism, or of intoxication, or otherwise of drugging. (This detail will be of no avail unless the person be brought for examination immediately after the rape was committed.)

(2) Whether the female walks as if in pain.

(3) Whether she appears of robust constitution, or whether there are signs of a low state of health, strumous habit, etc.

(4) Whether she has the general appearance of a masturbator.

Having remarked on the points and made sufficient general inquiries, let the female be undressed. Institute a thorough investigation, with professional assistance if possible.

IV. Examine the clothes worn at the time of the alleged rape. Preserve such portions as may be necessary for microscopic examination for—

(1) Blood. (Note if the stains are uniformly red or marked by want of uniformity, suggestive of the admixture of blood with mucus.)

(2) Semen.

(3) Other discharges.

(4) Mud, dirt, etc.

(Note if any of the clothes worn at the time of the alleged rape are torn, and, if so, the position of the rents. Record, further, if there are any indications of the clothes having been recently washed.)

Note with respect to stains—

1. That the presence of a blood-stain does not prove connection against the consent of the female, nor that the injury, even supposing the blood to have come from the genitals, was the result of violence from intercourse. Such injury might arise from the introduction of a foreign body, or of the fingers, or be due to menstruation. The absence of blood, moreover, does not prove that the charge of forcible rape is untrue.

2. That the presence of a seminal stain on the garments of the female is strong presumptive evidence that a rape, or an attempt to rape, has been committed, although it in no respect fixes the crime on any one individual. The absence of seminal stains is no proof that the charge of rape is unfounded.

3. That with respect to stains arising from other discharges, it is practically impossible to differentiate the character of a discharge (*i.e.*, whether it be gonorrhœal, leucorrhœal, etc.) by the appearance of the stain.

4. That it is most important to compare mud-stains that may be found on the clothes of the accuser with mud-stains existing on the coat or trousers or other garments of the accused; and, further, to compare both with the earthy matter found at the precise spot where the assault was said to have been committed.

V. Whether the breasts are virginal, or show signs of having been manipulated, etc.

VI. Carefully examine and record all general injuries or marks of violence on the body of the female.

Note with respect to such general injuries—

(1) Their character, size, and exact position.
(2) Their probable age.
(3) How far they coincide with the story told by the victim.
(4) Whether the injuries could have been self-inflicted.
(5) Whether they could have been inflicted by others for a malicious purpose.

(*Note.*—Marks of general violence constitute most important evidence. It should be carefully considered whether the marks of injuries correspond or not with the alleged cause.)

VII. Carefully examine and record the appearance in detail presented by the genital organs:

A. External genitals.

Note.—(1) The presence of swelling, redness, tenderness, bruises, wounds, lacerations, etc.
(2) Whether the vulva or the hairs on the vulva show any appearances of being massed or clotted. (If this be the case, the hairs are to be cut off and preserved for microscopic examination.)
(3) Whether any dried blood-stains on the genital organs be visible.
(4) The probable date of the several injuries observed.

B. Internal genitals.

Note.—(1) Is the perineum or fourchette lacerated?
(2) Is the hymen ruptured or inflamed?
(3) Are the carunculæ apparent, and, if so, what is their condition?—*i.e.*, are they small and colorless or large and inflamed?
(4) Is the vagina narrow and rugose?
(5) Are there any signs of disease, such as noma, etc.?
(6) Are there any syphilitic sores?
(7) What is the probable date when the injuries noted on the female were inflicted?

If the existence of syphilis or gonorrhœa is indicated, inquire—

(1) All particulars as to time, date, etc.
(2) Whether the female has been exposed to the possibility of infection otherwise than by intercourse?

(*Note.*—If there be extreme tenderness and swelling, make as full an examination as possible at the time, postponing a more complete examination until the swelling has subsided.)

Supposing marks of violence on the genitals are found—

(1) Consider whether such marks may result from masturbation, or be self-inflicted, or result from the introduction of foreign bodies, etc., or be inflicted by others for a malicious purpose.

(2) That, given signs of non-virginity, intercourse is not necessarily established because marks of violence be present.

(3) That, given marks of injury caused by intercourse, such intercourse may have been by consent.

(4) As a rule, therefore, the medical jurist should content himself with merely stating the marks observed by him, without stating their cause.

Supposing no marks of violence on the genitals be found—

(1) Consider whether the interval since the crime was said to have been committed is sufficient to explain the disappearance of such marks.

(2) If the examination be conducted immediately after the crime was said to have been committed, and the victim be of tender years, the absence of all marks of genital injury is strong presumptive evidence that a rape has not been committed.

(3) On the other hand, if the victim be accustomed to sexual intercourse, the absence of marks of injury on the genitals is no certain proof that a rape has not been committed.

VIII. Examine carefully any discharge from which the female is suffering, remarking its character (*i.e.*, whether it be thick or purulent, etc.), its quantity, its probable source, etc.

Inquire—

(1) Whether the female suffered from any discharge previously to the alleged rape having been committed, and

(2) If not, how soon afterwards did the discharge occur?

(Supposing a discharge be present, the question will be all-important whether the accused is suffering from gonorrhœa or not.)

The medical jurist should not commit himself as to the exact nature of the discharge.

Examination of the Place where the Crime was said to have been perpetrated.

Note.—(1) Whether the ground shows any marks indicative of a struggle.

(2) Whether any articles of jewelry, dress, etc., can be found on the spot where the rape was alleged to have been committed, such as might lead to identification, or otherwise be important as evidence.

(3) Whether the character of the mud or of other materials likely to cause marks on the clothes (such as paint, tar, etc.) corresponds with marks usually found on the garments of the accuser or of the accused.[1]

Evidence of Rape after Death.—The medical examiner may be required to give an opinion as to the nature of injuries discovered upon the dead body in a case of suspected rape. It is of the greatest importance for

[1] Legal Medicine, vol. iii.

.... *Diagnosis,*..............................

RECORD OF EXAMINING PHYSICIAN.
(EDGAR AND JOHNSON.)

(Date),..*18*........

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ce,..

............*years,*..................*months. Birthplace,*..

ı this country,..

ınd race,... *Occupation,*...................................

t to office by...

said to have occurred...*18*.......

....

ıation: (Date),.................................*18*......... *Place,*.......................................

l between injury and examination,..

l condition,..

of struggle or violence,...

ı vaginæ admits..................*fingers.*

bia; anus; vulvar canal; fourchette; vulvo-vaginal glands; hymen; carunculæ mes; clitoris; urethral meatus; discharge: urethral and vaginal; vagina; cervix; stains; skin; breasts.)

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ce of venereal disease,..

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nation of discharge and stains,..

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ısis,...

cate submitted (copy of),..

ks and subsequent history,..

harge. Plea. Verdict.)

the medical examiner to determine whether such injuries as might be found were of ante- or post-mortem infliction, and also whether they were sufficient to cause death. If the wounds discovered upon the cadaver were sufficient to cause death, the question arises, Were they the result of the act of rape, or were they produced otherwise? To ascertain these important facts, an exhaustive, and not a superficial, inspection of the body should be made. The corpse should be examined for bruises, fractures, etc., and the mouth particularly for foreign bodies. The vagina and the pubic hair may show the presence of spermatozoa; but the latter, in the absence of any statement on the female's part, would indicate only that sexual congress had been effected. Edgar and Johnson[1] say, "The difficulty will be very great in case of external violence to decide whether the marks were due to rape or to some other cause; in the vast majority of examinations it will be impossible. In the case of a very young girl, who had not reached the age of consent, the presence of injuries about the genitals points clearly to rape; but in a young woman the signs of defloration, no matter how pronounced and how recent, how extensive the inflammations and lacerations, can only be accepted as such, for they do not prove that she did not permit the intercourse. When added to these, however, are other marks of violence and a struggle, coupled, perhaps, with a previous character for chastity in the dead, the evidence is circumstantially in favor of the inference of a rape upon her."

CHAPTER XXXVII.

IMPOTENCE—STERILITY.

General Considerations—Definitions—Causes of Impotence and Sterility—Procreative Power in the Male Subject—Procreative Power in the Female Subject—Legal Relations.

SOME authors limit impotence to males and sterility to females; but in this work the writer will arrange the subject as follows: (1) impotence in man, (2) impotence in woman, (3) sterility in man, and (4) sterility in woman.

Impotence in the male may be defined to be the incapacity of the person for sexual intercourse, although the venereal desires are not extinct. This absence of the procreative power may depend upon a physical or a psychical cause. Of the *physical causes*, disease and the congenital malformation or defect of the sexual apparatus are the most important, although physiological perversion is sometimes grouped here. Incapacity of the

[1] Op. cit., vol. ii. p. 460.

may be due to such diseases as *atrophy of the testicle* or fungous
rths of the organ. The former may result as a consequence of gonor-
al epididymitis, varicocele, and syphilitic orchitis. These causes of
phy are not amenable to cure, and are, therefore, permanent. *Fungous*
ors may sometimes be removed by surgical means, thereby removing
physical cause. It is important in these cases for the medical examiner,
en questioned as to the relative prospect of a cure following medical
tment, to be able to say whether such be possible or not. Rules are
available for his guidance, so that his professional knowledge will be
only assistance. He should be able to point out the main causes of the
ction, as also whether they are remediable or not. Other diseases of
testicle which may not only render the male incapable of performing
sexual act, but also cause sterility, are syphilis, cancer, and tubercu-
s. Wasting of the testicles has followed parotitis, and paraplegia has
n referred to by some authors as being a bar to sexual congress. Inju-
to the head and spinal column have likewise produced impotence, as has
masturbation. Speaking of general diseases, Tidy[1] says, "We may
e that any cause which decreases bodily vigor probably decreases sexual
ver. Thus, advanced disease of almost any kind, or the extreme physical
akness resulting from fevers, etc., may induce both impotency and ste-
ty. Diabetes is usually accompanied with incompetency. On the other
nd, the author knows of cases of advanced heart- and lung-disease
thisis) in which coitus (followed by the birth of a child resembling the
her) took place only a few hours before death."

Besides the physical causes, the *mental condition* of the subject may
such as to render sexual intercourse impossible. Men who are other-
se in perfect physical and mental health, and who can perform the
ual act normally under certain conditions, are perfectly helpless when
se conditions to which they are accustomed are removed. Other psy-
ical causes of incompetency are mental anxiety, fear, a highly worked-up
agination, or emotional feelings. These causes are, as a rule, only tem-
rary. They are remediable by careful advice and assuring counsels. It
netimes happens that a perfectly healthy man will find himself utterly
apable of the act of intercourse at the moment of coitus, although pre-
us to that time the sexual desire was intense and the erection of the
is perfect. Sturgis[2] says that "there is no physical reason for this
ad; the patient is perfectly capable of performing the sexual act; and
when he is with the woman he is perfectly useless as a bedfellow; and
entimes the mere dread of failure, if failure has once occurred on attempt-
coitus, puts an end to all future attempts. There is often a physical
use for this mental disturbance,—such, for instance, as hyperæsthesia of the
ep portions of the urethra, slight and irritable urethral strictures, hemor-

[1] Op. cit., vol. iii. p. 13.
[2] Hamilton's System of Legal Medicine, vol. ii. p. 501.

rhoids, fissures of the anus and rectum, or a subacute inflammation of the neck of the bladder; and the well-informed surgeon will carefully search in such cases for any physical cause to account for the patient's sexual condition, and, if such exists, by removing the physical cause cure the sexual disturbance."

Congenital absence of the penis, or, if present, its diminutive or inordinately large size, torsion of the organ upon its axis during erection, etc., are purely physical causes of impotence, without the influence of the mind regarding the sexual act. Other etiological factors in impotence are castration of both testicles, malformation of the urethra, as hypospadias and epispadias. Reese says, "The mere absence of the testes from the scrotum does not produce impotence, for such persons (*cryptorchids*) are capable of begetting children."

It is of importance to remember, in connection with this subject, that a male may be impotent without being sterile, and, on the other hand, sterile without being impotent.

Procreative Power in the Male.—This usually commences when the male has arrived at the age of puberty. Until this period has been reached the sexual apparatus, particularly the testes, is small and undeveloped. The latter organs grow very little in proportion to the other parts. At puberty the organs of generation should be perfectly developed. The age at which puberty appears is subject to considerable variation, although it is usually from fourteen to seventeen years. Previous to this period the semen contains no spermatozoa. (*Vide* page 503, foot-note.) Impregnation, to a great extent, depends upon the activity of movement of the spermatozoa, their deficiency in the aged male being, no doubt, a fruitful cause of impotence, while the feeble motion of these small bodies might also reduce the power of impregnation. The procreative power in males is absent until the spermatozoa have made their appearance in the semen.

If a male person enjoys perfect health, this power of procreating may last for a great many years; in fact, to a very advanced age. Reese states that spermatozoa have been discovered in the semen at even above the age of eighty. Various kinds of accidents, such as injuries to the head and spine, and diseases (disorders of the brain and spine, malignant fevers, etc.), impair and destroy the procreative power in the male.

Sterility in the Male.—When the secretion or elimination of the spermatozoa is interfered with, either congenitally or as the result of accident, sterility results. There are, however, certain diseases which interfere with the normal functions of already existing procreative powers. Thus, the vasa deferentia may be obstructed by such affections as gonorrhœal epididymitis, syphilitic epididymitis, tubercular epididymitis, syphilitic and tubercular orchitis, cancerous or sarcomatous orchitis, atrophy from blows, or from an old varicocele, etc. (Sturgis.) Indulgence in sexual pleasures—excessive sexual intercourse and masturbation—may produce a temporary sterility in males, in which case microscopical examination of the seminal

ıid will show the existence of certain anomalies, such as a diminished ıantity of spermatozoa and an irregularity in form of those present. The ːmen likewise may be thin and viscid-like and without spermatozoa. In ıese cases careful treatment of the patient will often work wonders; in fact, ıay ultimately cure the abnormality.

Impotence in Woman.—This may depend upon organic or functional ıuses. The former include certain malformations of the genital apparatus f the woman. Thus, the most common cause of an organic nature would e absence of the vulva or vagina, etc. Vesico-vaginal and recto-vaginal ıalformations are also among the principal etiological factors of impotence ı woman. Absence of the vulva or vagina would constitute *complete* impo-ence, and a partially developed vaginal canal *incomplete* impotence. Hence e see that the perfectness or imperfectness of impotence will depend upon ıe nature of the organic lesion. Other causes of female impotence are xtroversion of the bladder, especially of its anterior wall; an imperforate nd tough hymen, although amenable to proper treatment; and certain iseases, as vaginismus, hysteria, etc. Sexual intercourse would not be in-ːrdicted by absence of the uterus, nor by the presence of a double vagina nd uterus.

Procreative Power in the Female.—This power manifests itself at ıuberty or the period at which menstruation is established, and ceases to act ıpon the stoppage of this periodical flow. The other changes in the female ıoticeable at puberty are enlargement of the mammæ, widening of the pel-ris, the appearance of hair on the pubes, mons veneris, and labia majora, illing out of the body in general, and transformation of the character. This is the period of fitness for reproduction, since evolution and menstrua-tion are established. The causes which influence the first appearance of the menses are climate, race, residence, heredity, and the so-called genital sense.[1] In temperate climates menstruation usually manifests itself at from thirteen to fifteen years of age,[2] it being earlier in warm and later in cold climates. Females who reside in the city and are not accustomed to out-door life menstruate earlier than do those who live in the country and enjoy healthful exercise and out-door life. The periods normally appear every twenty-eight days, although some females, perfectly healthy, menstruate very three weeks, while others do so only every five weeks. The average luration of each menstrual period is between three and four days, but in this lso there are variations,—viz., from two to eight days. Women have onceived who have never menstruated, and in some instances the func-on is absent throughout life. It is also important to remember that irls have menstruated as early as one, two, or three years of age, and that ıenstruation has not ceased in some women until the sixtieth, seventieth,

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[1] The greater or less vigor exhibited in the growth of ovisacs.

[2] Cases are on record in which the latest periods were from nineteen to twenty-hree years.

and even the eightieth and ninetieth year. Such cases are, however, of extremely rare occurrence. Reese[1] says that "the continuance of menstruation is usually indicative of the power of conception. Its termination nearly always marks the cessation of the woman's ability to bear children. But it is undeniable that women have conceived after the cessation of the catamenia. The latest age for pregnancy cannot be absolutely fixed, although it is comparatively rare after forty-five years, and almost unknown after fifty-five years."

Sterility in Woman.—This may be defined to be "the inability to procreate or a want of aptitude for impregnation." The causes of sterility are numerous, the chief one being absence of the ovaries, either congenital or as the result of surgical interference. Among other causes are extreme flexion or version of the uterus, an acid condition of the vaginal and uterine secretions, imperforate hymen or vagina, ovarian or uterine tumors, constriction of the os uteri, and functional derangements, such as amenorrhœa, profuse leucorrhœa, debility, dysmenorrhœa, etc. A fact of importance to recollect is that some women are sterile with one man and fruitful with another. (*Vide* last paragraph.)

Legal Relations.—Divorce may be instituted on the ground of impotence; and, furthermore, legal grounds for separation may be afforded in certain cases where hysteria and vaginismus prevail to such an extent as to prove an impediment to the marital obligations of the person so affected. On an application for divorce on the plea of impotence, an examination is essential, which must be voluntary, both upon the part of the man or woman so affected. The court may require this, unless the inspection was made previous to the bringing of the action. Baldwin[2] says that "a certificate by the examining physician is not receivable in lieu of his appearance as a witness. . . . Long and unexplained delay on the part of the petitioner in seeking a divorce will bar the remedy. Ignorance of the existing defect will not excuse the delay, if there was the means of knowledge and a want of reasonable diligence in seeking to obtain it. (Newell *vs.* Newell, 9 Paige's Chan. Rep. 25; B——n *vs.* B——n, 28 Eng. Law and Eq. Rep. 95.) It is not necessary to prove impotence generally, and as to all women. It is enough to establish its existence so far as the intercourse with the petitioner is concerned. A failure to consummate the marriage after three years of cohabitation is presumptive evidence of impotence."[3]

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[1] Medical Jurisprudence.
[2] Hamilton's System of Legal Medicine, vol. ii. p. 520.
[3] Anonymous, 22 English Law and Equity Reports, 637.

CHAPTER XXXVIII.

MEDICAL EXAMINATION OF THE LIVING.[1]

Trial by Inspection—Examination in Cases of Alleged Pregnancy—Examination in Proceedings for Divorce on the Ground of Impotence or Sexual Incapacity—In Cases in Chancery—Inspection of the Child in Filiation Cases—On a Question of Personal Identity—Compulsory Inspection of the Body in Actions for Personal Injuries, etc.—*Medical Malpractice—Railway Injuries.*

TRIAL BY INSPECTION.—This form of trial is frequently resorted to n order to determine collateral questions as they arise in legal proceedings ; other words, questions of capacity to commit crime in various cases. In ncient procedure the examination was made use of to ascertain the chief sue in an action at law, in which case it was made by the magistrate or agistrates, who gave their judgment without the intervention of a jury. his mode of trial seems to have been in use where the question of non-age as in dispute (3 Bla. Com. 332 ; 9 Co. Rep. 31) ; in questions of personal lentity (3 Bla. Com. 332 ; 9 Co. Rep. 30) ; of idiocy (3 Bla. Com. 332 ; 9 o. Rep. 31) ; on an appeal of mayhem (3 Bla. Com. 332 ; 2 Roll. Abr. 578) ;[2] n actions of trespass for mayhem (3 Bla. Com. 332 ; 1 Sid. 108) ; or for an trocious battery (3 Bla. Com. 332 ; Hardr. 408).

In modern procedure this form of (natural) evidence is called for (1) in ases of alleged pregnancy in capital cases, (2) in divorce proceedings, (3) n cases in chancery, (4) in cases of disputed identity, and (5) in accident ases in actions for personal injuries.

Examination in Cases of Alleged Pregnancy.—This is called for in hose cases where women are sentenced to death. Such persons frequently eign pregnancy to stay the infliction of capital punishment. In such in-tances, and in those where the woman is really in that condition, it has been e custom in all civilized countries to ascertain by an inspection of the per-n's body whether she be *enceinte* or not. The early common-law rule of actice exempted a pregnant woman from capital punishment until after her livery. According to its proviso, a jury of twelve matrons, or discreet males, was summoned to prove or disprove the fact of pregnancy under the rit *de ventre inspiciendo*. At the present time such a mode of examination ould not be tolerated, and it has been condemned by modern medical au-ority, and superseded by a jury composed in whole or in part of physi-

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[1] Cases requiring examination of the insane are not considered here.

[2] In this connection it may be added that appeals of mayhem were abolished by atute. (59 Geo. III., ch. 46.)

cians.[1] In some of the United States, however, there is no such provision, but it is the common practice of the court to appoint medical experts in these cases.

Examination in Proceedings for Divorce or Nullity of Marriage.—"In an action for separation on the ground of impotence, the plaintiff may be ordered by the court to submit to an examination. This opinion is sustained on the ground that the very nature of the case renders other proof impossible. (Devenbagh *vs.* Devenbagh, 5 Paige, 554, Court of Chancery, N. Y.) But an order for an examination will not be granted unless the complaint is preferred in good faith." (Briggs *vs.* Morgan, 3 Phillimore, 325, 328; s. c., 1 Eng. Ecc. 490; 2 Hagg. Con. 324.) Furthermore, according to Thompson (Law of Trials, 1, 648), "A court will be more reluctant to order an inspection of the body of an old person than that of a young person; and, for equally obvious reasons, it will be more reluctant to grant an inspection of the body of a wife than that of a husband; though an inspection of the wife is sometimes ordered where she herself is the complainant, since the impediment to the consummation of the marriage may exist in her, and since the fact of her virginity may be of itself evidence of his incapacity. (Shafto *vs.* Shafto, 28 N. J. Eq. 34; Brown *vs.* Brown, 1 Hagg. Ecc. 523; s. c., 3 Eng. Ecc. 229; Anon., Dean & S. 333.) . . . Where, as in some American jurisdictions, divorce cases have been committed to courts of chancery, a *reference* has been ordered to a *master*, directing him to conduct such an examination and report the result thereof. (Devenbagh *vs.* Devenbagh, 5 Paige (N. Y.), 554, 558.) An *ex parte* examination by the party's own physician will not satisfy the demands of justice, but the defendant will be required to submit to an inspection by one or more respectable gentlemen of the medical profession, to be named for that purpose by the complainant with the sanction of the court. (Newell *vs.* Newell, 9 Paige, 25.) In another case a commissioner was appointed to take proofs, to select disinterested physicians, and through them to make such an examination. (Le Barron *vs.* Le Barron, 35 Vt. 365, 372.) In the English Ecclesiastical Court the examination was conducted by medical inspectors, generally two physicians and a surgeon, or two surgeons and a physician, nominated by the complainant, with the privilege conceded to the adverse party of naming one or more of them. (Coote Ecc. Prac. 388.) They, of course, take an *oath* faithfully to perform the duty required of them. (2

[1] Arizona Penal Code, §§ 6, 1845, 1846, requires a jury of three medical men. California Penal Code, § 1221, a jury composed of three physicians. Idaho, Rev. Stats., §§ 8017, 8018, a jury of three physicians. Massachusetts, Public Stat. of 1882, chap. 215, 35, "must appear to the satisfaction of the governor and council," who would no doubt summon physicians. Minnesota Stats. of 1891, § 6883, "to the satisfaction of the governor," who would probably summon a physician. Mississippi, Code of 1892, § 1450, "six physicians, if to be had," etc. In New York, Code of Civ. Proced., § 500, sheriff of county where conviction occurs must empanel a jury of six physicians to inquire as to pregnancy.

ishop Mar. & Div. 598; Coote Ecc. Prac. 389; Browne Div. Prac. (fourth d.) 622, 623. The form of oath is given in 2 Bishop Mar. & Div. 598.) They certify to the court the result of their examination. (For forms of such ertificates, see L. *vs*. H., 4 Swab. & Tr. 115, etc.) Their certificate merely tates the *result* of their inspection, in conformity with the oath which they ave taken, but does not give the *reasons* for their conclusions. (Pollard s. Wybourn, 1 Hagg. Ecc. 725, 727.) In this regard it resembles a special erdict. In addition to requiring a written certificate, delivered under the bligation of the oath which they have taken, it is the constant practice of he English ecclesiastical courts to examine them as *witnesses* touching the esult of their inspection." (Deane *vs*. Aveling, 1 Rob. Ecc. 279; W. *vs*. H., 2 Swab. & Tr. 240; M. *vs*. H., 3 Swab. & Tr. 517, 520; M. *vs*. B., 3 Swab. & Tr. 550, 553.)

In cases in Chancery, where the question arises whether an heir preumptive, or a person to whom a devise is made or real estate given by will or the remainder of the devisee's natural life, in tail or in fee, is entitled to uch, an examination may be ordered before admitting such person to the enjoyment of an estate. (1 Bla. Com. 456; Lord Belmore *vs*. Anderson, 4 Bro. C. C. 90; *ex parte* Aiscough, 2 P. Wms. 591.)

Inspection of the Child in Filiation Cases.—Thompson[1] says, relatively to the trial of an action which involved the question of the legitimacy of a child who was alleged to be of mixed African blood, "It was held proper to allow the child to be exhibited to the jury, since, 'when the question is whether a certain object is *black* or *white*, the best evidence of color would be the exhibition of the object to the jury. The eyes of the members of the jury must be presumed to be as good as those of medical men. Why should a jury be confined to hearing what other men think they have seen, and not be allowed to think for themselves?' (Warwick *vs*. Warwick, 76 N. C. 179.) In a previous case in the same State it was held no ground of new trial that the mother of the bastard child was put upon the stand having the child in her arms, and that the solicitor called the attention of the jury to the child's features, and afterwards commented upon its appearance in his address to the jury,—the defendant having taken no objection. The court said that it had long been the practice in that State, in bastardy cases, to exhibit the child to the jury. (State *vs*. Woodruff, 67 N. C. 89.) In a similar case in another jurisdiction it was held not error to allow a bastard child about *two years old* to be exhibited to the jury for the purpose of enabling them to determine whether there was a *family resemblance* between the child and the defendant. (State *vs*. Smith (Ia.), 6 N. W. Rep. 153; s. c., 22 Alb. L. J. 43; s. c., 30 Am. Rep. 387.) But in another case in the same court it was held error to allow a child *three months old* to be thus exhibited. (State *vs*. Danforth, 48 Ia. 43; s. c., 30 Am Rep. 387.) The distinction drawn by the court between these two cases was that where a child has reached a considerable

[1] Op. cit., p. 651.

maturity family resemblances will appear; whereas all extremely young babies look substantially alike."

Examination of Plaintiff in Actions for Personal Injuries.—*Has the court power to order an inspection of the plaintiff's or injured person's body for the purpose of determining the extent and nature of the injuries?* The right of the defendant to secure an order for such an examination has been denied by some of the courts.[1] On the other hand, other courts, "taking the more enlightened view that the object of a judicial trial is to enable the State to establish and enforce justice between party and party, have held that it is within the power of the trial court, in the exercise of a sound *discretion*, in proper cases, and upon an application seasonably made, under proper safeguards designed to preserve the rights of both parties, to order such an inspection, and to compel the plaintiff or injured person to submit to it. (White *vs.* Milwaukee, etc., R. Co., 61 Wis. 536; Walsh *vs.* Sayre, 52 How. Pr. 334; Shepard *vs.* Mo. P. R. Co., 85 Mo. 620; s. c., 55 Am. Rep. 390, etc.) Another court has held that where the plaintiff in such an action alleges that his injuries are of a permanent nature, the defendant is entitled, *as a matter of right*, to have the opinion of a surgeon, based upon a personal examination, unless there is already an abundance of expert evidence, in which case, in its discretion, it may refuse to order an examination. (Sibley *vs.* Smith, 48 Ark. 275; s. c., 55 Am. Rep. 584.) Another court has ruled that the trial court may require the plaintiff in such an action to submit to a medical examination, and *dismiss his action* if he refuses to comply with the order." (Miami, etc., Co. *vs.* Baily, 37 Ohio St. 104.[2])

The court has power, under the New York statute, to direct the examination of a person *before trial*, so as to give the defendant time in which to prepare for trial. It lies within the power of the court whether such inspection shall or shall not be ordered. In the States of Iowa, Ohio, Minnesota, Nebraska, Wisconsin, Kansas, Georgia, and Alabama the practice of the courts has been to issue orders authorizing the *ante*-trial examination of the plaintiff.

The physical examination of the plaintiff in actions for personal injuries is not performed before the jury, since an indecent exposure would thereby be effected. (Brown *vs.* Swineford, 44 Wis. 282, 285.) Furthermore, as Thompson[3] says, "While the court, for obvious reasons, will not make an

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[1] Stuart *vs.* Haven, 17 Neb. 211, 214; Sioux City, etc., R. Co. *vs.* Finlayson, 16 Neb. 578, 588; Loyd *vs.* R. Co., 53 Mo. 515 (overruled by Shepard *vs.* Mo. Pac. R. Co., 85 Mo. 629); Parker *vs.* Enslow, 102 Ill. 272, 279 (where the point is slurred over without discussion); Neuman *vs.* Third Ave. R. Co., 50 N. Y. Super. 412; Roberts *vs.* Ogdensburgh, etc., R. Co., 29 Hun. N. Y. 154. In Texas it is ruled that the court will not compel a plaintiff suing for personal injuries to submit his body to examination, unless it is essential to the ends of justice. International, etc., R. Co. *vs.* Underwood, 64 Tex. 464.

[2] Thompson's Law of Trials, vol. i. p. 653.

[3] Op. cit.

rder for such an examination to be had *ex parte*, or by surgeons selected by ne party alone, without an opportunity for surgeons selected by the other arty to be present, yet where the party has been examined *ex parte* without an order of the court, there is no rule of evidence which will exclude he testimony of the examining surgeons (Louisville, etc., R. Co. *vs.* Falvey, 04 Ind. 409, 417), provided their testimony does not come within the rule which excludes confidential communications between patient and physician." The plaintiff may be directed by the court to perform physical acts before he jury, for the purpose of showing the character of the injuries, but the ropriety of such an order must rest in the discretion of the trial court. The right of the defendant to such an order might be disallowed, as in the ollowing case. In an action against a railway company for damages, it appeared that the plaintiff, while leaving the defendant's cars, fell or was hrown from the platform or steps of the car upon the ground, injuring the ciatic or great nerve of the thigh. The plaintiff, as a witness in her own ehalf, testified that this had occasioned great and constant pain, had caused he thigh to shrink, had rendered her lame, and had caused her to "limp" n walking. The counsel for the defendant thereupon requested the court o order her to walk across the court-room in the presence of the jury, which he court declined to do. The reviewing court saw, under the circumstances, no abuse of discretion in refusing to comply with the request. "Such an act," said the court, "would have furnished the jury little or no aid in determining the extent or character of her injuries. The only fact it could by any possibility have determined was whether or not she was lame, or 'limped,' as she testified, in walking. But there was already ample and uncontradicted evidence of this fact. Her own evidence on the point was fully corroborated by that of three or four other witnesses, her neighbors or members of her family, who had seen her almost daily since the accident." (Hatfield *vs.* St. Paul, etc., R. Co., Minn., 22 N. W. Rep. 178; s. c., 33 Minn. 130.) It may be doubted whether this was a sound conclusion. The fact that there was considerable evidence from the plaintiff herself and her neighbors to prove that she limped does not make it appear why the defendant was not entitled to an exhibition of her manner of walking before the jury, for the purpose, if possible, of showing the contrary, or at least of showing the extent to which she limped. It is true that the experiment might, if fraudulently performed by her, confirm her testimony and that of her witnesses on the point; but this would seem to be no reason for refusing the experiment on the application of the defendant.[1]

The question as to whether the plaintiff can be proceeded against for refusing to undergo an examination, as ordered by the court, may arise. "In Elfers *vs.* Wooley, 116 N. Y. 294, the court held that a charge to the jury that it might take into consideration the fact that the plaintiff had refused to permit his person to be examined by a physician, when requested to do so

[1] Thompson's Law of Trials, vol. i. p. 656.

by the defendant, as bearing upon the credibility of the plaintiff's statement concerning his injuries, is not error. The court also held that it was not error for the trial court to refuse to charge the jury that the refusal of the plaintiff to submit to such an examination raised a presumption that his injuries were not as severe as he claimed, putting the decision upon the ground that the charge above quoted was as favorable as the defendant could ask. It appears, however, from inspection of the printed record on the appeal in that case, that no objection was taken to the admission of the evidence concerning the plaintiff's refusal to submit to an examination. Hence, the evidence being before the court without objection, it might well be said that it was for the jury to determine what force and effect should be given to it. It seems to the writer of this article that where there is no statute permitting the courts to require such an examination, and hence where it is held, as in the Botsford case and the McQuiggan case, cited above,[1] that the refusal to submit to such examination is a matter of right, evidence that the plaintiff did so refuse should not be held admissible or permitted to militate against him upon the trial of his case. On the other hand, where there is a statute, as in New York, permitting the court to order an examination by a physician whom it designates, it would certainly seem to be the law that the refusal of the plaintiff to submit to such an examination could be proved against him on the trial, in addition to any remedies the court might have for enforcing its order requiring an examination to be had."[2]

MEDICAL MALPRACTICE.

Definitions—Care, Skill, and Diligence—Errors in Judgment—No implied Warranty to cure the Patient—Consultation with other Physicians—Gratuitous Services—Contributory Negligence of Patient or Attendant—Liability of Partners in Medicine—Action barred by Recovery for Services—Malpractice as a Defence to a Suit for Services—Evidence—Damages—Criminal Liability.

Definitions.—Malpractice, from the Latin *mala praxis*, may be defined to be bad or unskilful practice in a professional person, such as a physician, dentist, midwife, etc., whereby the patient's health is injured or death follows the treatment.

Wilful malpractice takes place when the physician or surgeon purposely administers medicines or performs an operation which he knows or expects will end in injury to the patient's health, endanger his life, or cause his death, as in the case of criminal abortion. Malpractice is said to be *negligent* when there are no criminal or dishonest motives on the part of the medical attendant; but, instead, there is gross negligence or failure to render that attention to the patient which his situation requires. The administration of medicines while in a state of intoxication, or the performance of a surgical operation

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[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. iii. p. 257.

[2] Ibid., p. 258.

while under like conditions, from which the patient might suffer injury, would come under this heading. *Ignorant malpractice*, on the other hand, consists in the administration of medicines or the performance of operations which do injury, and which an educated physician or surgeon would recognize as unsuitable.

Fowler[1] says, "The passive malpractice involved in allowing a patient to bleed to death without ascertaining the source of the hemorrhage or taking proper measures to arrest it is quite as reprehensible, *cæteris paribus*, as the active malpractice involved in causing a dangerous hemorrhage for want of proper care. Errors of omission, however, are of as great importance as those of commission, yet the former are apt to be judged less harshly than the latter. But it would be better, viewing the matter from a purely professional and scientific stand-point, to reject all artificial distinctions and consider only the behavior of the surgeon with relation to the nature of the disease, the condition of the patient, and the particular procedure claimed to be at fault."

Care, Skill, and Diligence.—Physicians, surgeons, and dentists, when summoned to treat a case, are supposed to be possessed of the reasonable and ordinary qualifications of their profession; they do not, however, pose as guarantors to cure. They are, nevertheless, expected to exercise reasonable and ordinary care, skill, and diligence. That is the extent of their liability. *What constitutes reasonable and ordinary care, skill, and diligence?* The law requires of physicians, surgeons, and dentists the reasonable and ordinary care, skill, and diligence which is commonly practised by professionals in the same general neighborhood, and in the same general line of practice in like cases. In McCandless *vs.* McWha, 22 Pa. St. 261, the court said that the degree of skill necessary was that "which ordinarily characterizes the profession;" but in a preceding portion of the opinion the court said "that it was such skill as thoroughly educated surgeons ordinarily employ," which would probably indicate that this latter is the test which the court intended to prescribe.[2]

A patient who had been properly treated for a fractured leg was discharged before it had regained its strength without having received instructions as to its care. The surgeons were held liable for negligence in not furnishing the necessary instructions, the patient having subsequently suffered the loss of his limb because he used it improperly.[3]

The law does not expect a physician or other professional person engaged in the practice of the medical science, who practises in a sparsely settled district, such as a village or small town, to exercise the same care and skill as would be expected of one residing in a large city, where the opportunities of keeping fully alive to the latest methods and appliances are

[1] Hamilton's System of Legal Medicine, vol. ii. p. 573.
[2] American and English Encyclopædia of Law, vol. xiv. p. 78.
[3] Ibid.

greater. Such persons are only bound to exercise the average degree of skill possessed by the profession in such places generally.

A patient who had been improperly treated, as a result of the neglect of the medical attendant to employ the most modern and improved methods of practice, could very properly bring charges of neglect against the attendant, who, however honest in his method of treatment, would be liable if his patient suffered injury to his person. Furthermore, the medical attendant would be liable if he discontinued his visits and attention to the patient before giving the latter notice of his intention. The law requires him to "exercise reasonable and ordinary care and skill in determining when his attendance should cease."

Errors in Judgment.—Medical practitioners are required to give their patients the benefit of their best judgment, although they do not render themselves liable for a mere error of judgment. If, however, the latter be inconsistent with reasonable care, skill, and diligence, they would be liable. (West *vs.* Martin, 31 Mo. 375; Howard *vs.* Grover, 28 Me. 97.)

No implied Warranty to cure the Patient.—As intimated before, the medical practitioner does not obligate himself to cure a case of disease or injury, unless by contract, in virtue of which, should harm follow such obligation, he would be liable. Reese[1] says, "The medical man should always beware of compromising himself by a *promise* to cure his patient; if, however, he be so unwise as to have made such a *contract*, he will be held by the law strictly accountable for its performance. In case of failure it will be no defence for him to allege the occurrence of unforeseen contingencies; these he was bound to have knowledge of. Neither may he allege a want of sufficient skill or dexterity; these he is supposed by the law to possess when he undertook the case."

Consultation with others.—It sometimes happens that the physician or surgeon is not competent or feels that he is not able to meet the exigencies of the case. In such an instance it would be his duty to either recommend the employment of another, or, if he feels competent himself but harbors doubts concerning the case, he should seek consultation with other physicians and surgeons. It is competent in an action for malpractice for the defendant to show that he engaged another physician or surgeon to assist him in the case. (Jones *vs.* Angell, 95 Ind. 376.) The refusal to accept the assistance of another medical man would impose no higher duty upon him. (Potter *vs.* Warner, 91 Pa. St. 362; 36 Am. Rep. 668.)

Gratuitous Services.—The fact that a medical man renders services gratuitously does not affect his duty to exercise reasonable and ordinary care, skill, and diligence. (McNevens *vs.* Lowe, 40 Ill. 209.) Gratuitous treatment of a patient by a practitioner does not imply that the latter is privileged to treat the former other than in a scientific and careful manner. The

[1] Op. cit., p. 653.

that for eighteen months a physician had abstained from making a m for compensation for his treatment of a case might, in an action for lpractice, and particularly in a doubtful or balanced case, be urged with at force as in the nature of an admission of neglect or want of skill, as dence on the part of the medical attendant that he was not entitled to pay his services, and that they were valueless. It furnishes a collateral issue on which the defendant is summoned to give explanatory or contra-tory evidence, and by which the jury may be embarrassed in its delib-ations.[1]

Contributory Negligence of Patient or Attendant.—A patient or endant who refuses to co-operate with his physician or surgeon by neg-ting or refusing to employ the remedies prescribed, or who declines to ow the performance of a necessary surgical operation, cannot recover malpractice unless the injury is traceable to the medical attendant's iorance.[2] The information, however, which a practitioner furnishes his tient relative to his trouble should be considered by the jury in deter-ning the question whether the patient, in neglecting to follow the physi-n's advice, was or was not guilty of contributory negligence.[3] *Experi-ntal surgery* is not permissible by law without liability to damages should e experiment result in the injury or death of the patient. In some in-nces, however, experimental treatment is not necessarily culpable of itself, ice it would be impossible to frame a legal code embodying the rules the science of medicine. (Fowler.) The refusal to permit a physician surgeon to experiment to remedy another practitioner's mistake could ve no effect in mitigation of damages.[4]

If the contributing causes of injury or disease arise from the patient's n natural temperament or physical weakness, recovery for malpractice nnot be entertained. (Simonds *vs.* Henry, 39 Me. 155; Haire *vs.* Reese, Phila., Pa., 138, etc.) Where the injury attributable to the patient's usal or neglect to follow the directions of his medical attendant can be parated from the fault of the practitioner in his conduct of the case, mages for so much of the injury as is due to the latter's neglect may be covered by the former.[5] The patient cannot, however, claim damages of e medical attendant for the results of his management of the case, if he

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[1] American and English Encyclopædia of Law, vol. xiv. p. 81; Baird *vs.* Gillet, N. Y. 186.

[2] "If the patient, by refusing to adopt the remedies or comply with the directions the physician, frustrates or defeats the endeavors of the physician, or if he aggra-tes the case by his misconduct, he cannot charge to the physician the consequences e distinctly to himself." (Jones *vs.* Angell, 95 Ind. 376.)

[3] American and English Encyclopædia of Law, vol. xiv. p. 81; Geiselman *vs.* ott, 25 Ohio St. 86.

[4] Ibid., p. 81; Chamberlain *vs.* Morgan, 68 Pa. St. 168, etc.

[5] Ibid., p. 82; Hibbard *vs.* Thompson, 109 Mass. 286; Wilmot *vs.* Howard, 39 447.

gives direction as to how his treatment shall be carried out according to his own judgment.[1]

In an action for malpractice the burden of proof to show contributory negligence rests upon the defendant. (Gramm *vs.* Boener, 56 Ind. 497. A contrary rule is adopted in Iowa. Baird *vs.* Morford, 29 Iowa, 531.)

Liability of Partners in Medicine.—Where two or more medical men engage in the practice of their profession as partners, all are liable for malpractice by any member of the copartnership. (Hyrne *vs.* Erwin, 23 S. Car. 226; 55 Am. Rep. 15; Whittaker *vs.* Collins, 34 Minn. 299.)

Action barred by Recovery for Services.—A recovery by a medical practitioner for his services will act as a barrier to any future action for malpractice, with some exceptions. (Bellinger *vs.* Craigue, 31 Barb. N. Y. 534; Blair *vs.* Bartlett, 75 N.Y. 150; Gates *vs.* Preston, 41 N. Y. 113.) In some of the States, however, it is held that if recovery be by confession or default, it is not a bar. (Ressiquie *vs.* Byers, 52 Wis. 650; 38 Am. Rep. 775; Skyes *vs.* Bonner, 1 Cin. Super. Ct. 464; Goble *vs.* Dillon, 86 Ind. 327; 44 Am. Rep. 308; Am. and Eng. Enc. of Law, 14, 83.)

Evidence in Malpractice Cases.—It is competent, as a rule, to show the general reputation of the defendant for skilfulness and learning. (Leighton *vs.* Sargent, 27 N. H. 460; Am. and Eng. Enc. of Law, 14, 83.) In some States, however, this form of evidence as a defence to an action for malpractice is not allowed. (*Ibid.*, Holtzman *vs.* Hoy, 19 Ill., App. 459; Carpenter *vs.* Blake, 66 Barb. N. Y. 448; 50 N. Y. 696; 10 Hun. N. Y. 358; 75 N. Y. 12; Williams *vs.* Poppleton, 3 Or. 139; Mertz *vs.* Detweiler, 8 W. & S. Pa. 376.) The mere failure on the part of the medical practitioner to effect a cure of his patient's ailment raises no presumption of a want of proper care, skill, and diligence. (Tefft *vs.* Wilcox, 6 Kan. 46; Haire *vs.* Reese, 7 Phila., Pa., 138; *Ibid.*, 14, 83.)

Hypothetical questions may be put to a witness by the plaintiff if based upon the facts constituting the alleged malpractice. "There is no objection to asking an expert witness what, assuming the testimony to be true without summarizing it in the question, his opinion is as to the treatment." (*Ibid.*, 14, 84; Wright *vs.* Hardy, 22 Wis. 348; Gates *vs.* Fleischer, 67 Wis. 504.) It is not, however, proper to include any supposition not borne out by the evidence. (Reber *vs.* Herring, 115 Pa. St. 599; Mayo *vs.* Wright, 63 Mich. 32; *Ibid.*, 14, 84.) Where an action has been brought against a surgeon for malpractice in the treatment of an injured limb, the plaintiff may be permitted to show the injured member to the jury. (Fowler *vs.* Sergeant, 1 Grant's Cas. Pa. 355; *Ibid.*, 14, 84.) In a suit brought several years after the injury, it was held proper to allow the plaintiff to show the injured limb to the jury. (Carstens *vs.* Hanselman, 61 Mich. 426.)

Damages.—In an action to recover damages for malpractice the plaintiff may recover, although the practitioner was summoned and paid by another.

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[1] Gramm *vs.* Boener, 56 Ind. 497; Hancke *vs.* Hooper, 7 Car. & P. (Eng.) 8.

Nugent *vs.* Boston, etc., R. Co., 80 Me. 62; Gladwell *vs.* Steggall, 5 Bing. N. C. 733; 35 E. C. L. 392.) The husband of a woman who has suffered death through unskilfulness in performing a surgical operation may recover damages from the surgeon for causing the death of his wife. (Cross *vs.* Guthery, 2 Root, Conn. 90; 1 Am. Dec. 61.)

Under the Indiana acts, 1879, p. 160, a married woman may sue alone for injury caused by malpractice. (Barnett *vs.* Leonard, 66 Ind. 422; Am. and Eng. Enc. of Law, 14, 84.)

The measure of pecuniary damages in an action for malpractice would be as follows: (1) loss of time and labor arising from the injury sustained by the malpractice; (2) the reasonable expenses incurred for surgical, medical, and other attendance in consequence thereof; (3) diminished capacity to work at the trade or business of the injured party in consequence thereof; (4) bodily pain and mental anguish in consequence thereof. Regard is also to be had to the nature of the injury, whether it be temporary or permanent, and also to the situation of the injured party. (Field's Medico-Legal Guide, 225, and Am. and Eng. Enc. of Law, 14, 84.) In an action against a practitioner of medicine for malpractice it is not competent to show declarations of the practitioner indicating ignorance for the purpose of increasing damages. (Am. and Eng. Enc. of Law, 14, 85; Grannis *vs.* Branden, 5 Day, Conn. 260; 5 Am. Dec. 143.) "The question as to the amount of damages belongs to the jury. In relation thereto they have a very broad discretion. The general rule has been that a new trial will not be granted in an action of this kind for excessive damages unless they are so clearly excessive as to indicate that the jury acted from prejudice, partiality, or corruption, or were misled as to the measure of damages. That the jury assessed higher damages than the court would have assessed is no reason why the verdict should be set aside." (*Ibid.*, Kelsey *vs.* Hay, 84 Ind. 189.)

An instruction to a jury, in a case where no wilful negligence has been shown, that they may find a verdict for any sum they see fit, up to the amount claimed in the complaint, if they believe that the defendant was wilfully negligent, is improper. (*Ibid.*, 14, 85; Wenger *vs.* Calder, 78 Ill. 275.)

What are termed compromise verdicts are not looked upon with favor in malpractice cases. Each party has a right to insist that the jury, and each juror, shall render a verdict, if at all, according to the law and the evidence as given on the trial. (*Ibid.*, 14, 85. "It is the duty of each juror carefully and patiently to canvass and consider the evidence, in all its bearings, with an honest and conscientious effort to reconcile any difference that may exist between him and his fellow-jurors as to the truth of the matters put in issue, and with a willingness to adopt the views of his fellow-jurors when he can see that they accord with the law and the evidence. But it would be a gross wrong to one or the other of these parties to carry the spirit of compromise to the extent of yielding to that which you do not believe to be true, and to render a verdict, merely for the sake of compromise, that you do not believe to be in accordance with the truth." Heath *vs.* Glisan, 3 Or. 64.)

e is civilly responsible when his assistants, through ignorance or care-s, injure his patient, but he is not accountable for any wilful crim-t upon their part; (13) he is not responsible for errors of judgment re mistakes in matters of doubt and uncertainty; and (14) he is not ned to engage for extraordinary skill or for extraordinary attention re.

RAILWAY INJURIES.[1]

ks—Injuries of the Back—Nervous Shock—Traumatic Hysteria—Malingering—Medico-Legal Aspects.

ilway injuries, aside from their surgical interest, assume other de-of importance of no less interest to the medical jurist, who may be ed to appear in court to testify as to their gravity or reality when iary compensation is asked by the real or alleged injured person. The ity of being familiar with the more common effects of railway injuries t be questioned, since any physician or surgeon may be compelled to a witness after having rendered assistance to such an injured individual. present time suits for damages are of such frequent occurrence that edical man must be extremely cautious when called on for an opinion the prognosis or gravity of a traumatism resulting under the above stances. Experienced surgeons are fully aware of the many attempts by unscrupulous persons to enlist their services as a means of extorting sums of money from railway companies for injuries which in reality do ist. So clever, sometimes, are these persons that their simulation of jury they pretend to be afflicted with baffles the most experienced and ble practitioners. Hence the great importance of a correct diagnosis se cases; in fact, under such circumstances the question of railway in-calls for the highest degree of skill, in order to be able to distinguish tely between genuine and fraudulent claims for damages.

e number of persons in the United States who annually present them-as claimants for damages against railway corporations for injuries or less severe is very large indeed. Out of this number a great pro-n of the cases are fictitious and fraudulent. It may readily and with-xaggeration be stated that more or less misrepresentation exists in t every instance of railway injury. "In the great majority of cases," Hamilton,[2] a "good verdict brings with it a complete cure, and patients have been brought into court upon a litter, surrounded by tearful and sted friends and attentive physicians, whose cases have been dramati-described to the jury, leave the court-room, and a few days or weeks he swindle engage in their regular pursuits as if nothing had happened. o be regretted that in such cases physicians have been found who have

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Vide the larger works upon the subject for a more detailed description of these s.

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been willing to testify to the existence of serious organic disease of th vous system when no evidence of such was presented except the pa unreliable and prejudiced statements."

Of two hundred and thirty-four cases of suits for damages, cit Page,[1] a great majority were fraudulent or exaggerated. Of twenty reported by Rigler, seven were simulated, and in thirteen the diagn regard to fraud was questionable. The following case, reported by Hodges, is a characteristic one in so far that it illustrates how a jury w to believe the plaintiff and award him the damages demanded, no standing the fact that the claim was fraudulent. "In 1872 the Metrop Railway, of Boston, Mass., was mulcted by a jury in a sum of ten tho dollars in the case of a man whose detailed symptoms satisfied them t was utterly enfeebled in body and wholly unable to earn his own living the close of the trial the plaintiff celebrated his victory by becoming up ously drunk, and it required the united strength of three policemen t him to the station-house." (*Vide* also Malingering.)

During the year ending June 30, 1894, 1823 employees of railwa the United States suffered death from railway accidents, and 23,42 injured, as compared with 2727 killed and 31,729 injured in 1893. number of passengers injured fatally was 324, an increase of 25, an number hurt was 3304, a decrease of 195. The ratio of casualty to t lers was one passenger killed out of 1,912,618 transported, or for 44,103,228 miles travelled, and one injured out of 204,248 carried, each 4,709,771 miles travelled. These numbers serve to indicate the a wholesale destructive power of railways.

The object of this chapter is to furnish the medical jurist with an ac of the spinal injuries which are so frequently the result of railway accid hence the subject-matter will embrace none of the many other for violence so prevalent in these cases, since they differ in no respect those which are observed in many other ways.

Injuries of the Back.—The frequency of this form of injury yond question. Statistics show that it is a most common result of r collision, and, as Page states, fully sixty per cent. of those injured i manner suffer more or less from the effects of the concussion to the There seems to be in these cases a marked difference between the in to the back occurring to passengers and those affecting employees railway upon which both are carried. There is also a difference of r According to Outten,[2] of eighteen thousand eight hundred and eight injuries to those in the employ of the railroad, ten hundred and fourte volved the back. Of this number five hundred and nine showed onl tial or no external evidence of injury. Twenty-six cases were concu

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[1] Injuries of the Spine and Spinal Cord, etc., 1885.

[2] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, p. 574.

of the cord, and eighteen concussions of the brain and spine combined. Of eight hundred and forty-four injuries to passengers, one hundred and twenty-seven instances showed slight or no external evidence of injury to the neck. The most frequent cause of these injuries is the jar or jolt, or what the French call *embrouillement*, the sharp vibration that is transmitted after the complete arrest of motion. In addition to this, sudden and violent strains and wrenches due to great muscular excitation, sudden prehensile movements, and force directly applied to the back are evident etiological causes of injury to this part of the body.

Injuries to the back, the result of railway collisions, may be observed in any of the following forms: (1) simple lumbar sprain (traumatic lumbago); (2) cervico-dorsal sprain; (3) sprain of the entire vertebral column; (4) lumbar sprain, with very acute pain; (5) sprain of the dorsal and lumbar vertebræ, with hyperæsthesia of the surface; (6) severe general vertebral sprain, with sensations of numbness and tingling; (7) severe lumbo-sacral sprain, with probable injury to the cords of the sacral plexus; (8) lumbo-sacral sprain, with probable injury to or hemorrhage round the pelvic plexuses; and (9) late myelitis following obscure spinal injury.

In *simple lumbar sprain*, the result of slight collision, if the subject be otherwise of robust constitution, the only probable local manifestation of the effects of the accident would be a simple sprain of the ligaments and muscles about the lumbo-sacral region,—in other words, the patient would be suffering from a traumatic lumbago. In such an instance the passenger was probably suddenly thrown backward and forward in the car, although the sudden arrest of the motion of the train might result in such injury. Again, the muscles and ligaments attached to the spinal column are frequently thrown into a tetanic state by the conscious or unconscious effort of the subject at the moment of the collision, for the purpose of offering resistance to the almost immediate shock to the cord. The effect of this resistance on the part of the traveller is usually the stretching, straining, or even rupturing of these structures.

A *cervico-dorsal sprain*, as the result of railway collision, may be followed by a momentarily acute pain in the cervico-dorsal region of the spine. After the acute character of the pain has passed off, the part involved by the accident may still be the seat of a weary aching for several weeks. This may occur over and on either side of the spinal column. Other indications of injury are absent, and the nausea and vomiting usually experienced at the time of the accident soon pass away. The nature of this form of injury is precisely the same as that mentioned in the case just cited.

In *sprains of the entire vertebral column* the victim may complain of feeling sick at the stomach, although no vomit is present; pain seizes him within a couple of hours, and tenderness will be experienced in the lower part of the back, particularly over the two lower dorsal and two upper lumbar vertebræ. The after-results in cases of this kind are apt to be rather severe. The patient may complain, even a month after the infliction of the

injury, of severe pain throughout the whole spine, together with difficulty when the attempt to move is made. Peripheral pain is not present in these cases, and the pulse and temperature are, as a rule, normal.

In any of these three forms of injury to the back, nervous shock may be experienced by the subject.

Stiffness, tenderness, and pain are the most prominent symptoms of *simple sprain of the back.* These signs may exist at any portion of the spinal column, or may involve the whole of it. Added to these signs are others as *sequelæ,—i.e.*, extreme difficulty in moving the head, limbs, or body, accompanied by severe pain. This latter may be so intense as to cause the patient to be extremely wary in making such movements. Difficulty in walking is another sign of diagnostic importance in these cases. The injured person may also experience considerable difficulty in urinating. This is probably due to inability of the lumbar muscles to act as a support and help during the act of micturition. Irritability of the bladder may be another trouble, a symptom that may become of great inconvenience to the injured person. "When the nervous system has been much upset by the shock of the accident, you may find a condition of 'nervous bladder,' in which the patient has a frequent desire to pass water, with inability at the same time to perform the act perfectly, and consequent slight dribbling at its close." (Page.)

Another manifestation of the same muscular incapacity is constipation, which gives rise to the fear of paralysis supervening, which is further increased by the peculiar sensations incidental to the incapacity of the muscular and ligamentous attachments already alluded to. These cases of pseudo-paralysis, if not understood, may be the cause of unnecessary alarm.

Sprain of the dorsal and lumbar vertebræ, with hyperæsthesia, is a form of injury which may result from a collision of no great severity. Thus, in a case cited by Page,[1] "a young man was slightly shaken in a collision, and in a few days had pains about the vertebral column. He gradually recovered from the effects of the shake, but the aching in the back continued, and the spine was therefore more especially examined, not much attention having been paid to it hitherto. The examination revealed a point of tenderness on pressure over one of the dorsal vertebræ, at the point, in fact, where the sprain had probably been most severe. Within a day or two his back became so sensitive that he complained of and shrank from the very lightest touch of the finger on almost every part of it, whether over the spinal column or over the muscles at the side. He was so sensitive to touch that he endeavored to avoid being touched at all, seemed even afraid to have his back looked at, and moved himself away with so much contortion as in itself to afford evidence of the absence of any serious mischief about the vertebral column or its contents. The hyperæsthesia was doubtless perfectly genuine; but, in addition to the mode of onset, observe the inconsistencies of the hy-

[1] Op. cit., p. 17.

eræsthesia itself. So great was it that, had it been real and not imaginary, must have been unbearable for the man either to have rested against his couch or even to have borne the contact of his clothes. This is the hyperæsthesia so often found superadded to the pain which is a real consequence of the vertebral sprain; and yet too frequently the inconsistencies thereof are ignored, and the hypersensitiveness is regarded as another and more telling symptom of some inflammatory condition of the membranes of the spinal cord. It has little in common, however, with the hyperæsthesia or the *eccentric* pains which are a result of irritation of the sensory nerve-roots, whether by thickening of membranes or otherwise; and it is unlike the zone or girdle of hyperæsthesia which may feel to the patient like a cord or some other abnormal sensation at the periphery. The hyperæsthesia is too widespread over one area, and is at the same time too limited to the area which is the chief seat of attention. It is, moreover, unlikely that real irritation of the sensory nerve-roots should give rise to hyperæsthesia upon the back alone. It is rather the natural outcome of that alarm which, both in hospital patients and in those more especially who have been in railway collisions, seems to be inseparable from injuries to the back or spine; and although undoubtedly a real condition to the patient himself, it is yet unreal, and the product of his disordered imagination alone."

Besides the more immediate symptoms or signs (pain, tenderness, stiffness, and hyperæsthesia), there are others which deserve attention in these cases of injury to the back. Abnormal sensations of tingling and numbness in some parts of the extremities are not uncommon signs after rather severe railway collisions. In a case mentioned by Page[1] the patient complained of abnormal sensations in the limbs, which came on synchronously with the pains. This case was precisely similar to the one just quoted, with this exception. The sensations were general, and not confined to any one limb or part of a limb. They are probably due to some effect occasioned by the strain or blow upon the nerve-trunks proceeding from the spinal column to the extremities. "In severe collisions," says Page, "where there is a risk of the body being suddenly bent and strained in many different directions, it is indeed highly probable that every part of the spinal column is subjected to muscular and ligamentous strain, and it is not inconceivable that the nerves which permeate the column at both sides should be involved in the same injury."

In a case of *severe lumbo-sacral sprain, with probable injury to the cords of the sacral plexus*, the impairment of motion and sensation complained of was very likely the result of some injury to the nerve-trunks. In this case, beyond the bruising, there were no physical signs of injury to the spinal column. In addition to the paresis, injury to the muscular and ligamentous structures about the hips and pelvis was apparent. There was not, however, any paralysis of the bladder or bowel. The patient was completely

[1] Op. cit., p. 20.

cured at the end of three years. "It is impossible to say with certainty whether that injury was after the nerves had formed the plexuses outside the vertebral column or when they still were individual cords in the cauda equina. If the paresis was due to traumatic lesion of the nerve-trunks within the spinal canal, it is almost inconceivable that the effects could have been confined to the nerves of one limb only, and on this ground it seems more reasonable to conclude that the injury to the nerve-trunks was outside the vertebral column. The length of time, moreover, that elapsed before the recovery of the patient seems further to confirm this opinion, whether the essential lesion was of the nerves themselves or, as is equally probable from the character of the blow, was hemorrhage lying around and pressing upon them."

Late myelitis following obscure spinal injury was observed in a case cited by Page.[1] The patient, aged twenty-nine, was a thin and delicate man. He was injured in a very serious collision in which several persons were killed. As he was dazed at the time of the accident, he could furnish no accurate account of the occurrence. He was confined to his bed for about three weeks, suffering considerably from pain in his back and legs. He then improved sufficiently to be able to repair to a hydropathic establishment in the country, where he remained for two months. His back was a source of great trouble to him, but he was otherwise much improved. At the end of these two months the weakness of the legs observed before became a much more definite loss of power, and in a week or so he was unable to walk. Ten months after the collision there was no mistake as to his condition. He possessed no power of locomotion, and had almost entirely lost sensation in his legs. There was paralysis of the bladder and bowel, bedsores, and reflex spasms of the lower extremities, all of which pointed to softening of the cord. His temperature was supra-normal and his pulse frequent. The pain in the back was very much exaggerated, but there was no marked tenderness. After lingering some months without improvement, he died. As there was no post-mortem examination permitted in this case, Page suggests the following as a very probable sequence of events. "A small localized injury of the membranes, or hemorrhage at the site of the injury to the vertebral column, followed by a meningitis which was at first too limited in extent to give rise to any precise symptoms, but which proceeded and, having implicated the cord, was the cause of the myelitis which had a fatal issue. If this be the explanation, the meningitis must have been exceedingly limited, because traumatic meningitis does not usually follow an unobserved course. Sometimes it is acute, spreads rapidly, gives rise to definite symptoms, and has a fatal result. At other times a less violent inflammation leads to local thickening and adhesion about the spinal roots, causing peripheral symptoms of impaired innervation ; or similar pathologic changes may involve the cord itself, and setting up degeneration therein, pre-

[1] Op. cit., p. 25.

nite indications of structural disease. But acute myelitis at so al after injury is most uncommon. Still further doubt, however, s case; for at the time when the symptoms of spinal softening g marked the man had epididymitis. It is true that gonorrhœa r denied, and that the epididymitis may have been caused by ıse of the cathether; but it is to be remembered that myelitis ay be the result of thrombosis of the pelvic and vesical veins, a uence of the same urethral inflammation which had produced It seems, therefore, within the range of possibility that the he fatal result were not due to the injury at all."

umatic meningitis is rarely present in railway injury, although of by some authorities as occurring with seemng frequency. mmations of the spinal cord following this class of injuries are met with.[1]

Shock.—Concussion of the spine from general shock denotes disturbance of the nervous equilibrium rather than structural amage to any organ of the body. This class of cases is of ency in railway than in other injuries. Shock or collapse, in s degree, is an invariable accompaniment to sudden or severe er the latter be the result of railway or other accidents. The sness" has been applied to the state of shock from severe injury. wering of the vital powers,—a vaso-motor paralysis, affecting t and especially the abdominal vessels. The collapse may nd as to be more dangerous to the well-being of the patient ry which was the occasion of it. In such instances death may place, although such an issue is rather exceptional, especially ated cases. In the majority of cases a period of reaction suc- llapse of the patient. During this time there is a gradual re- revious state of health. The duration as well as the activity n is proportioned to the condition existing during the period or collapse. If the patient's system at the time of the accident itated state, due to disease, unusual privations, alcoholic ex- eaction in the manner just depicted usually fails to ensue, and ill pass into that state known as ***prostration with excitement.*** epends on proper treatment, which should of course be thor- d out. The prognosis in shock is always bad if the temperature 5.6° C. (96° F.), or if the reaction is delayed for twenty-four *e* Wounds.)

y conduce to shock, and in many cases it is responsible for the llapse or insensibility into which the victim is plunged. In es it plays an important part as being provocative of those

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er is referred to the special treatises upon the subject of railway injuries e other causes besides trauma which produce functional troubles in

after-effects or symptoms which figure so prominently in the medico-legal considerations of such cases. Jordan[1] says, "The principal feature in railway injuries is the combination of the psychical and corporeal elements in the causation of shock in such a manner that the former or psychical element is always present in its most intense and violent form. The incidents of a railway accident contribute to form a combination of the most terrible circumstances which it is possible for the mind to conceive. The vastness of the destructive forces, the magnitude of the results, the imminent danger to the lives of numbers of human beings, and the hopelessness of escape from the danger give rise to emotions which in themselves are quite sufficient to produce shock or even death itself. . . . All that the most powerful impression on the nervous system can effect is effected in a railway accident, and this quite irrespectively of the extent or importance of the bodily injury." Fear and profound mental emotion are in a great measure responsible as causes of the symptoms of nervous shock so commonly observed after railway collisions. "On the other hand," says Page,[2] "we may hear the condition regarded as evidence of serious and irremediable pathologic change in the chief centres of the nervous system; and, on the other hand, no clear history of pronounced shock or collapse at the time of the injury being forthcoming, the symptoms are deemed unreal, and the *bona fides* of the patient is called in question. The mistakes are at opposite ends, and I hardly know which is the worse for the patient who, really suffering and ill, lies in the condition in which we find him because his whole nervous system has received a shock, not so much from severe bodily injury, which shows itself in unmistakable signs, as from the impalpable element of alarm, which has to be measured by the events of the accident itself and by the temperament of the individual who has been affected thereby."

The symptoms of shock comprise disturbances of the circulation, disorders of secretion, catamenial derangements, derangement of the digestive and genito-urinary systems, headache, loss of memory, various ocular phenomena, nervousness, and sleeplessness. (1) *Disturbances of the circulation* are commonly observed in cases of general nervous shock. As is well known, shock is usually ushered in by smallness, feebleness, or slowness of the heart-beat. Sometimes it is scarcely perceptible. In the more serious cases, those based upon a combination of continued terror and emotion, the derangements of the circulatory apparatus are of longer duration. Palpitation is complained of, and the frequency of the pulse-beat may be so increased as to register 100 to 150 beats to the minute. These symptoms are, however, brought about by exciting causes other than the mere shock, a point of importance to recollect when examining the patient. Page[3] says, "A perfectly steady pulse throughout the whole examination tells its own

[1] Surgical Enquiries, second edition.
[2] Op. cit., p. 37. [3] Op. cit., p. 47.

ale. Nay, the rate, the character, and the excitability of the pulse form an almost metrical indication of the amount of disturbance of the nervous balance, strength, and tone; and the pulse is often the only sign there is to guide us to a right estimate of the patient's condition." Besides the changes of the pulse, derangement of the whole vaso-motor system may exist, as evidenced by the alternate sensations of heat and cold, flushing of the face, etc. All of the symptoms characteristic of disturbances of the circulation cease upon the patient's restoration to health. (2) *Sleeplessness*, in these cases, is a sign that shows the loss of tone and equilibrium of the nervous system, and its causes may be other than those arising from the original nervous shock. *Headache* is the principal symptom of neurasthenia. In this case it is present as occipital oppression or pain. It may be brought about by various means, such as the exciting causes of palpitation, or by derangements of the vaso-motor system, etc. (3) *Nervousness* includes a great variety of complaints and symptoms which, as Page says, "have no more substantial basis than the statements of the patients themselves." (4) *Disorders of secretion* are of frequent occurrence in cases of general nervous shock. One of the most common disorders of this function is excessive perspiration. Polyuria, menorrhagia, etc., are also evidences of a weakened state of the nerves which control the action of the secretory apparatus. (5) Of the various *ocular phenomena*, valuable evidence of the tone of the nervous system may be afforded by the size of the pupil of the eye. A small pupil, which very readily varies according to the degree of light admitted, is compatible with a healthy tone of the nervous system. On the other hand, a widely dilated and sluggish pupil is indicative of exhausted nervous strength. The deeper structures of the eye are rarely affected in spinal injuries due to railway collisions, although in some instances organic changes have been observed. (6) The *loss of memory* so often complained of by persons suffering from spinal injuries is not so much an inability to recall incidents of past life, etc., as it is a lack of the power of volitional attention, a state of the mind produced by a depressed and weakened condition of the nervous system. (7) *Catamenial derangements* are not uncommon in cases of nervous shock. Menorrhagia and suppression of the menses may occur in consequence of nervous shock. Suppression of the catamenia may follow immediately the general nervous prostration brought about by an accident, such as a railway collision. This suppression may last for months at a time; at any rate until the normal tone of the nervous system is restored. (8) The retention of urine is a marked symptom of profound shock. The sexual organs are likewise more or less affected in cases of depression of the nervous tone. Thus, the patient may experience difficulty in accomplishing conjugal relations; in fact, he may possess neither the will nor the desire. Sexual exhaustion generally lasts as long as the neurasthenia, and is, therefore, to be recognized as evidence of a depressed state of nervous tone in those so afflicted, be it accidental or otherwise in origin. (9) Of the *derangements of the digestive*

system in these cases, nausea and perhaps vomiting are prominent signs. In early collapse there is also a marked detestation for food evinced by the patient. The bowels are constipated and the tongue heavily coated. This state of affairs is likely to be in a measure the cause of the general wasting of the body so remarkable in all of these subjects. (10) Page[1] states as a remarkable fact that railway collisions rarely cause abortion or premature labor, "strong evidence that the concussion is not as violent as it is often thought to be, for disturbance of the uterine contents is one of the recognized causes of induced labor."

The prognosis in cases of neurasthenia is, as a rule, good, and with proper treatment complete restoration of the patient's normal health probable. But, on the other hand, cases occur where the patient dies from depression of the vital powers as a result of the depressed state of the nervous system.

The causes which operate to prolong the above-referred-to symptoms are so fully and exhaustively treated in special works upon the subject that their consideration in a work of this description would overreach the bounds of this section; hence the reader is referred to such special works for their proper consideration. Suffice it to say that the neurasthenical and hysterical disorders of the nervous system are so linked together that their common manifestation in a case is by no means a rarity. Age, sex, the state of the subject's health anterior to the infliction of the injury, the condition at the time of the injury, and that subsequent to it are all factors affecting the symptoms in these cases.

Traumatic Hysteria.—Hysteria, like neurasthenia, may be caused by traumatism, such as the injuries a person receives in a railway collision. This mental state is rarely observed after accidents of any other kind, probably on account of the lesser degree of mental shock that accompanies them. One of the main causes of the onset of hysterical phenomena is fright, and this is especially the case with women, who readily succumb to it. Hysteria is, however, occasionally met with among men. Of the predisposing causes of this emotional condition, recent illness, sexual excesses, alcoholism, overwork (mental and physical), and the gouty diathesis are most prominent.

Symptoms.—The signs of hysteria which are apt to follow a railway collision are as follows Great alarm and agitation are the first disturbing influences of the accident. In a few hours, or even days, the emotional symptoms are developed. In the first place occur the convulsive sobbings, cryings, and laughter; or, again, the patient may become irascible, and even threaten violence to those about him. Everything he attempts, such as the ordinary duties of life, is done in a constrained and unnatural manner. He becomes despondent, and his face appears pinched and haggard; but his digestive organs, as a rule, remain unaffected. Pain may be com-

[1] Op. cit., p. 54.

ined of, the seat of which will usually correspond with the part of the dy affected by the collision. It may be diffused, consisting in great rt of what is termed epidermic tenderness. The spine, as a rule, is the rt complained of, and although the patient may assert that the pain is ery great, examination will generally reveal the non-existence of organic disase such as would account for the excessive agony described by the sufferer. urthermore, the patient will be able to move about freely and to dress and ndress himself without apparent effort, showing the want of consistence etween the pain and the freedom of his movements. The exaggerated nguage by which the sufferer describes his pain is an unconscious stateent which is not uncommon in such persons. This state usually continues r some time without material improvement, although there may be weekly termissions. It is, however, dependent upon the condition of the patient's nd, and until that improves will manifest itself. If there be no organic nplication, the patient ought to improve rapidly as soon as the anxieties nnected with business reversals in consequence of the accident, the forced inquishment of work, and the prospect of an impending litigation are noved. Erichsen[1] says, "Anxiety of mind has much to do with the deopment of the symptoms. They arise in the first instance from the ony of fear into which some individuals are thrown on the occurrence of r great catastrophe. It is not given to every one to be able to preserve mness of mind in the midst of the crash and confusion of a railway colon. . . . These anxieties once removed, the mental tone speedily benes restored, that power of self-control which has been lost is regained, d the emotional condition and its concomitant phenomena which are conquent upon a temporary suspension of the power of will speedily dispear."

The *diagnosis* of hysteria accompanying shock is frequently beset with any difficulties, especially when the symptoms of organic injury are obured by those arising from the purely emotional or hysterical state. The ental state of hysterical subjects develops rather speedily after the collision. n this way it differs from the slow mental derangement resulting from chronic ritation of the brain or its membranes. Furthermore, the symptoms of ne hysterical state are continuous, not progressive. The pain differs enrely from that occasioned by organic disease. It consists of a rather difused epidermic hyperæsthesia rather than a localized tenderness. Again, ne functions of the different organs of the body are usually healthily perrmed. The *prognosis* may be said to be good, although in some cases the nverse may hold. (For more detailed information on this subject the ader may turn with profit to the larger special works.)

Malingering.—(*Vide* Feigned Diseases, etc.)

Medico-Legal Aspects of Railway Injuries.—This is one of the ost difficult subjects with which medical jurisprudence has to deal. Erich-

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[1] Concussion of the Spine, etc., 1883.

sen[1] says, "The importance of an attentive study of these cases does not consist merely in the great frequency of their occurrence, though in this respect they stand in an unhappy pre-eminence, greatly exceeding in number all other cases put together in which medicine and law are mutually brought to bear upon, and have to co-operate in, the elucidation of the truth. But the consideration of these cases from a medico-legal point of view is a matter of the greatest importance, by reason of the difficulties with which they are surrounded and the obscurity in which they are enveloped. In this respect their investigation resembles somewhat, and is only equalled by, that of cases of alleged insanity.

"In those cases of injury of the nervous system that become the subject of medico-legal inquiry, there is, as in cases of alleged insanity, no material difficulty experienced in the determination of the various questions that may arise in the more severe cases and obvious forms of disease. But it is far otherwise in the slighter and more obscure cases. In these not only may the question be raised as to the actual existence of the alleged symptoms, but, their existence having been admitted, the surgeon must determine the value to be put upon them as evidences of real organic disease or of mere functional disturbance. And in reference to the ultimate fate of the patient, he must state to what extent recovery is likely to take place and when it may be expected. In addition to all the intrinsic difficulties which are necessarily connected with such cases, there is underlying, and greatly disturbing their simple professional aspect, the great question of the amount of pecuniary compensation that should be granted for the consequences of the alleged injury. Here we have a disturbing element that, happily, never intrudes itself into other questions of surgery and into very few of forensic medicine. But it is an element of disturbance, to the effects of which due weight must be given by the medical attendant in so far as it affects the *morale* of the patient, for it is apt to influence him injuriously in more respects than one, by leading him either wilfully or unconsciously to exaggerate his symptoms, just as he is very apt to overestimate his business losses and the pecuniary expenses entailed by the injury. But, remember, if I advise you not to neglect to take this question of pecuniary compensation into your consideration, it is only so far as it affects the patient's symptoms and the estimate he forms of his own condition. In no other way can you as medical men—either as the surgeon to the railway company, or still less, if possible, as the private medical attendant of the patient—have anything whatever to do with the matter. This is a question that is altogether out of our province. A medical man who considers it in any way except in its influence on the mental—and, through that, on the physical—state of the patient, meddles with what neither concerns him nor his profession, and places himself in a false and unenviable position. Let me, therefore, urge upon you, when you are engaged in these compensation cases, never under any circum-

[1] Op. cit.

es to allow yourselves to be drawn into a discussion as to the amount of ey payment to be made to the sufferer, unless the matter is expressly red to you by the counsel employed by both parties. But even then I ld advise you, if possible, to avoid being placed in the undesirable po- n of arbitrator. You may be sure that neither party will be satisfied your decision. The fact is that a compensation claim for alleged injury ade up of various elements, of which the personal injury is only one. , which is alone the surgeon's province, in reality often counts for very in the case. The losses sustained in business; the expenses, medi- and others, directly incurred by the patient, or to which he is liable e put as the result of the injury, constitute, as a rule, the heavier and e important items in the claim for compensation; and these are matters lie in the province of counsel, attorneys, and accountants, and are al- ther foreign to that of the surgeon. Mental sufferings, bodily pain disability, the diminution of that physical and mental vigor in which enjoyment of life so largely consists, even complete annihilation of the pects of a life, weigh lightly in the scales of justice, which are made to the beam only by the weight of the actual money loss entailed by the lent."

he questions with which the medical examiner has to do, in a case of ed disease or disability due to railway injury, are, (1) Is the condition e individual real or feigned? (2) If the person be injured, what is the re and extent of the injury? (3) Are the injuries permanent or not? (4) If the injuries are not permanent, when will the patient be well n?

The difficulties that surround an investigation are often of the most per- ing nature, and it is by the most careful and painstaking examination that the physician will be able to arrive at any conclusive result. In ting a diagnosis, the physician who examines a patient should pro- l in a thoroughly systematic way, else disentanglement of the net-work notty problems with which he has to do will be an impossibility, and, ead of eliciting correct replies to his diagnostic questions, he will be e apt to find himself hopelessly floundering about, without support other his own inaccurate mode of procedure. Dana, of New York, suggests following outline as proper in cases of this kind:

1. Preliminary facts: name, age, sex, condition, nationality, occupation.
2. Family history.
3. Personal history.
4. History and causes of present disease.
5. Physiognomy of case: general appearance, nutrition, abnormalities, gait, etc.
6. Disorders, if any, outside of nervous sphere. Digestion, heart, lungs; temperature, respiration, pulse, urine.
7. Psychical sphere: mental condition, sleep, etc.
8. Motor sphere: paralysis, tremor, abnormal movements, atrophy, electrical and mechanical reactions of muscle and nerve; speech.

9. Sensory sphere.—General sensations: vertigo, pain, paræsthesia. Special sensations,—tactile: temperature, pain, muscular (ataxia); vision, hearing, taste, smell.
10. Reflexes, superficial, deep, organic.
11. Trophic, vaso-motor, and secretory disturbances.

CHAPTER XXXIX.

FEIGNED DISEASES.

Medico-Legal Relations—General Rules for Diagnosis—Simulated Diseases and other Affections—Factitious and Fictitious Wounds—Conditions other than Diseases that are simulated—The Simulation of Disease by Children.

Simulated Diseases are frequently the cause of medico-legal inquiry. Thus, soldiers, sailors, and prisoners often feign disease for the purpose of shirking their duties, or to secure a more comfortable mode of life. Such persons will resort to all sorts of pretexts in order to accomplish their purpose, and, as Chapman[1] says, "will indulge in the most disgusting performances, such as swallowing fæces, urine, blood, or mutilating themselves as occasion may require."

Civilians sometimes resort to the same fraud in order to prevent their appearance in court, to avoid jury duty, to escape military service, etc. Disease is frequently simulated by a purely mental effort on the part of the malingerer; while, on the other hand, mechanical contrivances are sometimes called in play to further the purpose. Thus, crutches, trusses, bandages, spectacles, etc., are included in the armamentarium of the deceiver. (*Vide* the special diseases, etc., for mention of other devices used by the malingerer.)

It may be mentioned, in connection with the subject of feigned diseases, that the motives which incite an individual to simulate disease are usually fear, gain, laziness, and notoriety. Malingering is not as common at the present time as it was formerly, although it is occasionally resorted to for the purpose of extorting money from private persons, cities, towns, or corporations.

"As regards the *mode of diagnosis*," says Reese,[2] "cunning and shrewdness must be met by the exercise of these same qualities on the part of the examiner. In nothing are experience and tact of greater assistance to their possessor than in the management of this sort of cases. The examiner should always bear in mind that simulation may be possible, and that this is

[1] Medical Jurisprudence and Toxicology, p. 146.
[2] Op. cit., p. 469.

ely to be practised in a given case if sufficient motive exists; he should y to discover this motive, using great caution in the attempt. Do not be ntent with a single examination of the patient, but surprise him with an nexpected visit, made soon after the first one. Observe him closely when e is not aware of your notice; by this means the deception may often be iscovered when he is off his guard. Ascertain whether the patient's ac-ount of the rise and progress of his disease is in accordance with the known nedical facts connected with the history of the real disorder. It is often seful to mention in the patient's hearing certain false symptoms of the al-eged disease, and afterwards ask him after these symptoms, when, if simu-ating, he will be very apt to enact them just as he heard them. Always uspect one who complains of a multitude of ailments, and which have no tual connection with each other. All local ailments on parts of the body vered with the clothing require to be examined with the parts uncovered; dressings and bandages must be removed. Do not be deceived by cica-ces, cupping scars, leech-bites, or blisters. No importance whatever is to attached to the statements of relatives or friends, since they would natu-lly sympathize with the patient. Anæsthetics (ether and chloroform) may metimes be employed successfully in suspected cases of contracture of the ine or muscles. A very successful method is to threaten, and even use, me very repulsive medicine or remedy, as powerful revulsives, and espe-lly the actual cautery; but there are some cases that prove obstinate and conquerable, even under this severe ordeal."

Simulated Diseases.—*Abdominal Tumors.*—These are rarely simulated the present time, although some cases have occurred recently. The mode simulation is by paddings worn in the dress, by causing rigidity of the cti muscles, by pushing the abdomen forward while in the erect position, nd by elevating the spine when in the prone position. A case is recorded[1] here abdominal distention was produced by the malingerer—a young soldier —swallowing air. Chronic constipation might be the means of producing a welling which would assume the feel of a tumor, especially if the collection f fæces be great. The medical examiner should make a very careful exami-ation of the uncovered abdomen, and cause the muscles to relax by raising nd drawing up the pretender's knees. Nauseous and antiflatulent purga-ives might be administered with benefit.

Abortion is rarely simulated, although such cases have been observed here black-mail has been the object of the malingerer. The symptoms igned are usually those of great prostration with irritation of the external enital apparatus. The clothing and body of the subject are usually stained ith blood. To detect the imposition the examiner should make a very reful vaginal examination, and also note the appearance of the mammæ, pecially the condition of the areola.

Apoplexy is feigned by the pretender falling down suddenly as if deprived

[1] Dictionnaire des Sciences médicale.

of consciousness. It is seldom simulated by malingerers. Powerful stimulants, sternutatories, the application of the electric battery, hot water, etc., will generally suffice to detect the impostor. The only benefit to be derived from this mode of simulation would be in cases where the object is to escape immediate punishment.

Anæmia is commonly feigned by causing the face to appear pale and the general condition of the body weak and trembling. The mode of detection consists in examining the character of the pulse, the action of the heart, and the state of the skin. In some cases the tongue is whitened by means of chalk, the trembling being produced by the use of tobacco, as from an old pipe, etc.

Amaurotic blindness is the form generally simulated. It is feigned by the application to the eye of the extract of belladonna or datura stramonium. This form of blindness is characterized by a fixed and dilated pupil. The patient should be carefully watched without his knowing of it. Tanner states that "where belladonna has been used we must wait for some days—even nine or ten—until its effects have ceased, putting supplies of this agent out of reach."

Asthma is simulated by assuming difficult breathing, increased on making any exertion. The simulator appears to be affected with cough, expectoration, and palpitation of the heart. In these cases the application of the stethoscope will usually suffice to detect the presence or absence of the disease. The patient should also be carefully watched without his knowledge.

Calculi in the bladder are simulated, especially by young women, by introducing such articles as cinders, gravel, pieces of bone, etc., into the vagina or urethra and bladder. Parker states that this form of malingering is a manifestation of hysteria gravis.[1] The simulation is readily detected by removing and examining (chemical analysis) the various particles or foreign bodies.

Cancer has been simulated by gluing to the skin the smooth surface of half of the spleen of an animal. This has the appearance of a malignant and cancerous ulcer. A careful inspection of the parts must be made in order to detect the fraud.

Catalepsy has been simulated in some of its imperfect varieties. The individuals who usually feign this affection are hysterical masturbating females, sailors, soldiers, etc. The person, according to Dunglison, appears suddenly to be motionless, the joints remaining flexible, and external objects making no impression. *Opisthotonos*, a form of *hysteria gravis*, has been simulated by the person assuming an arched position for some time. To detect catalepsy (simulated) the medical examiner should propose the use of the actual cautery. John Hunter's mode of detection was to "suspend from the outstretched hand of the impostor a string with a small weight at-

[1] Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. ii. p. 706.

ied to it, and, suddenly cutting the string, observed whether the arm was uptly raised, as it would be by an impostor."

Chorea has been simulated by the impostor assuming the absurd consive movements which are characteristic of that affection. It is a very ficult disease to counterfeit, and is seldom chosen by impostors for that son. To detect the fraud the person should be watched without his owledge. Again, by awakening him suddenly from a sound sleep and serving if the movements begin at once, a correct estimate of the case may made.

Convulsions, especially the convulsive movements of the facial muscles, sometimes feigned. Tanner states that "in the west of Scotland, in 1742, icks of convulsions—occasioned by religious excitement and enthusiasm ecame almost epidemic. Such was also the case in Cornwall in 1813 1814. Many of the Jansenists—the Methodists of France—who made rimages to the grave of Deacon Paris during their persecution in 1724, were there seized with fits, were doubtless impostors; but it cannot lenied that many credulous zealots actually worked themselves into consions by the force of their imaginations."[1]

In pretended cases the medical examiner will note that the stiffness of muscles and the resistance and rapidity of action which manifest themes in the real disease are found wanting. The suspected individual uld be most carefully watched without his being aware of such surveile. It will be found that the pretender will soon grow tired of the irkie movements.

Cutaneous Eruptions.—Parker[2] states that while a student in "Professor rdy's clinic at the St. Louis Hospital in Paris, I witnessed a severe case urticaria from indulgence in a quantity of strawberries. Some articles diet will produce these disturbances in the cuticle, and the knowledge ing been acquired by individuals, is used for purposes of fraud." Like iulations may be occasioned by the application of certain drugs to the dermis. Pustular eruptions are produced by the application to the skin ointments composed of tartar emetic, croton oil, etc. After a few days ve elapsed they greatly resemble the skin-disease known as impetigo. wdered cantharides have also been employed for purposes of deception. ticaria has been produced by eating shell-fish, bitter almonds, etc. To tect the fraud the medical examiner must make a careful inspection of the fected parts and also search for particles of the drugs employed in the ception.

Consumption has been feigned by coughing and causing emaciation by ntinued abstinence from food and the use of vinegar. The bloody exctoration can be effected by pricking the gums or fauces. In some innces the sputa is mixed with ordinary blood and pus, etc. The imposture n be detected only by making a careful stethoscopic examination. The

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[1] Clinical Medicine, 1859.

[2] Op. cit., p. 708.

microscope will be of material assistance in discovering foreign blood. This disease is frequently simulated by soldiers or sailors in the hope of securing a discharge. It is also feigned by those recovering from catarrh and bronchitis. *Hæmatemesis* has been simulated by swallowing blood and then vomiting it up in the presence of others. Microscopic examination of the fluid will usually detect the fraud.

Diarrhœa is frequently simulated by soldiers and sailors in hot climates. According to Hutchinson, "convicts break down in their urinary utensils a healthy evacuation, and intimately mix it with the urine, so as to imitate a diarrhœal stool, or add blood to it, procured by perforating the gums, so as to simulate *dysentery*." Mucous discharges have been produced by the introduction of suppositories of soap, etc., into the lower bowel. To render the stools black and of an unhealthy appearance the sulphate of iron has been taken. The detection of the fraud requires careful watching on the part of the medical examiner. The patient should be instructed to employ a night-chair, and his proceedings noted, and care must be taken to prevent him from obtaining blood by pricking his gums, etc. The linen also should be inspected. The real odor of dysentery is of course absent.

Dysentery.—(*Vide* Diarrhœa.)

Dropsy has actually been simulated by the French conscripts by injecting water into the peritoneum, and thereby produced fictitious ascites. (Tanner.) Concealed ligatures have been employed to produce anasarca of the limbs. *Hydrocephalus* has been produced in young children by the daily injection of air under the scalp. This mode gives rise to considerable distention of the parts, thereby readily simulating the affection referred to. Mode of detection: the abdomen and other parts must be examined with care; if a ligature has been applied to an extremity a mark will be left.

Dyspepsia is frequently resorted to as a form of disease readily simulated. Soldiers and sailors most commonly practise this form of fraud. In feigned dyspepsia, absence of the more constant symptoms of the real affection will be noted; the general health will also be found to be disproportionate to the disease. Tanner[1] states that "some people can vomit at will by pressing on the region of the præcordia, and they avail themselves of this faculty when simulating disease of the stomach. They also privately provide themselves with food which they do not vomit." It is extremely difficult to detect the imposition, especially where there is a certain amount of disease with great exaggeration. The person should be carefully watched without his knowledge.

Epilepsy.—Of this Parker[2] says, "The professional impostors of England, known as 'tumblers' or 'dummy chuckers,' who simulate epilepsy, have frequently been successful in deceiving medical men. The condition appeals powerfully to the sympathies of on-lookers. The foaming of the mouth after a sudden fall can be produced by soap, but the whole performance

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[1] Op. cit. [2] Op. cit.

impostor has usually been obtained by long and patient practice. ꞁing inquiries should be made from some intelligent witness as to the oms of the epileptic seizure." To detect the fraud, the use of sternuta- might be advocated. The proposal of an operation within the hear- the pretender will usually suffice to bring to light the real conscious- f the person. The employment of the actual cautery has also been ated in these cases.

ɪr, *Diseases of the.*—*Otorrhœa* is artificially produced by the intro- n of honey, pus, rancid tallow, etc., into the external meatus. Other r affections of the ear have been occasioned by the introduction within ꞁamber of the organ of cantharides or other acrid substances. It is imes difficult to detect these cases of simulation. The most careful ing and examination are the only means for the exposure of these

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ɪe, *Diseases of the.*—These are sometimes simulated for purposes of ꞁg pity, etc. The introduction of irritants into the eye is a mode of ng *ophthalmia.* Reese[1] states that "it is, however, detected by the ty of its progress, arriving at its height within a few hours after the ation of the irritant. In soldiers sometimes only one eye is affected, lmost uniformly the right one,—the one with which he takes aim. A ꞁnded man would probably inflict the injury on the left eye." (*Vide* ꞁrotic Blindness.)

ever may be simulated or produced by artificial means. According to ré, there are individuals who can readily simulate fever, being able to ꞁce an increased rate of pulsation, chattering of the teeth, and deep . The intermittent type of fever is usually selected for purposes of de- on. The tongue is often covered with soap, chalk, dust, flour, etc., in to give it an unhealthy appearance. Redness of the epidermis has produced by the friction of a hard brush. Parker[2] states that "fever toms may be excited by strong stimulants, such as wine, brandy, and e internal use of tobacco, which is generally known to act rapidly upon eart action. (Guy.) . . . Generally speaking, such factitious fevers are meral." In the latter case one or two days' examination will suffice to t the fraud. The tongue, etc., should also be examined, and, as Tanner s, "the general condition of the system will be found incompatible with ruth of the symptoms."

istula in the anus has been simulated by making an incision close to order of the anus and placing an acrid tent within it. To detect the lation an examination of the parts must be made.

Iemorrhages.—*Hæmoptysis* may be simulated by coughing and color- the saliva with blood obtained by pricking the gums or from other es, or the coloring may be obtained by using such substances as ver- n, brick-dust, etc. The patient should be examined by means of the

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[1] Op. cit., p. 476. [2] Op. cit.

stethoscope in order to detect the simulated signs of the affection. He should also be examined as to symptoms, sputa, etc.

Hemorrhoids have been assumed by introducing within the rectum the bladders of fish, etc., inflated and tinged with blood. The discharge of blood from the anus is easily simulated. These artifices will deceive no medical examiner.

Hepatitis is quite often feigned by soldiers in India who desire their discharge. Cheyne states, "When men who have not been in warm climates obstinately complain of pain in the right hypochondrium, and when we cannot discover any enlargement or fulness of the liver, when the pulse and breathing are undisturbed, the secretions and excretions natural, and when the alleged pain resists topical bleeding and blistering and mercurial purgatives, the sooner we send them to duty the better." The testimony of the malingerer will not coincide with the general appearance of the countenance, etc., while the absence of any enlargement of the liver is of itself exceedingly suspicious, although disease may be present without this symptom.

Hernia has been feigned by inflating the cellular tissue of the scrotum with air. Tanner states that some individuals possess the power of retaining the testes within the groin by the voluntary action of the cremaster muscles, and so occasion hypertrophy of the parts, which has been mistaken for hernia. The fraud is, as a rule, readily detected.

Hydrocele.—(*Vide* Hernia.)

Hydrophobia has been simulated. In a case mentioned by MM. Percy and Laurent, the subject *came to time* when he was threatened with suffocation between two beds.

Heart, Diseases of the.—The following is quoted from Parker's article.[1] "Simulation of diseases of the heart is less common among impostors, and means for its detection are readily available. The feebleness of the pulse, which has been produced by ligatures around the arm and by the use of internal remedies such as hellebore, is the most prominent symptom manufactured by the impostor. Dr. McClelland, of Albany, reported a case where a patient deceived the attending physician by placing his finger on the artery under the armpit whenever the pulse on the corresponding side was examined. Reese relates that certain individuals can produce feebleness of the pulse by taking a deep inspiration and suspending the breathing. Dr. Cheyne has reported the case of Colonel Townsend, where there was the voluntary suspension of the heart's action for a limited period. Digitalis, American hellebore, tobacco, and other drugs are capable of producing palpitation by internal or rectal use. Palpitation may also be excited by strong compression of the abdomen with a bandage; in this manner hypertrophy may be induced."

Hysteria is sometimes simulated, although the malingerer usually over-

[1] Op. cit., p. 711.

s the attack. The examination in these cases must be thorough, else the eption, especially in those cases where the hysterical convulsion has n brought about by an effort of the will, will be overlooked.

Insanity.—The reader is referred to works on that subject for reference its simulation. .

Jaundice has been simulated by tingeing the skin with an infusion of meric, while muriatic acid has been added to the stools for the purpose giving them the characteristic clay-colored appearance. The color of the ne has been heightened by means of rhubarb, and the temperature of : skin raised by the ingestion of large amounts of spirits. These latter o occasion the disordered condition of the tongue and the rapidity of : pulse. In real jaundice there is general malaise, depression of spirits, netimes melancholia, together with a yellowish tinge of the skin. This ter is almost inimitable. The application of snuff to the eyes has been orted to by some, in order to excite inflammation. To detect the fraud, : skin should be washed, in order to remove the coloring matter used by : impostor. The secretions become normal as soon as the supplies of acid, :., are stopped. The white of the eye cannot be colored by any means own to art.

Ophthalmia.—(*Vide* Diseases of the Eye.)

Ozæna is feigned by inserting within the nostrils a piece of sponge satu- ted with offensive juices or oils mixed with decayed cheese. The impo- ion is easily detected.

Palpitation.—(*Vide* Heart-Diseases.)

Paralysis is not often employed as a means of imposture. It is always a ispicious circumstance in the healthy adult when the loss of power is con- ied to one limb only. In a case discovered by Cheyne and quoted by anner, the former gave his opinion "that the disease was feigned, based pon these considerations,—viz., there existed no other signs of disease; the untenance indicated health and intelligence; the function of the brain was ndisturbed, and all the senses were entire." Parker quotes a case related y Hutchinson, where the latter "gave one of these impostors, who claimed) have paralysis of the arm, fifty drops of laudanum in his tea. When ound asleep the doctor tickled his right ear with a feather, and was re- rarded by seeing the lame right arm rise instantly." To detect the im- osture the most violent means should be resorted to, such as the application f the electric battery, etc. Feigned *palsy* should be treated in the same nanner.

Peritonitis is often simulated, especially by hysterical women. Inflam- nation of the peritoneum as feigned is thus described by Tanner:[1] "Great ain over the abdomen is complained of, the slightest pressure is said to give itense agony, and the patient excites herself until her skin becomes hot and ulse frequent." The mode of detection is to engage the person in conver-

[1] Op. cit., p. 136.

sation, "excite her attention, and then make pressure upon the abdomen; a simulator will feel no pain and utter no complaint. Examine the pulse, expression of countenance," etc. (Tanner.)

Phthisis Pulmonalis.—(*Vide* Consumption.)

Polypus nasi is an affection that is sometimes simulated, although such instances are of rare occurrence. The affection is imitated by inserting into the nostril the testicle of a young cock or the kidney of a rabbit, retaining it in place by means of a small sponge secured to it. The fraud may be detected by making a careful examination of the nose.

Porrigo is simulated by means of nitric acid or other irritants. Careful observation and restraint are the means of detection.

Prolapsus ani is rarely simulated. It is imitated by placing in the anus a portion of the intestine of an ox, containing a sponge saturated with a mixture of blood, milk, and the brains of a sheep. The imposture is easily detected.

Prolapsus Uteri.—(*Vide* Prolapsis Ani.)

Rheumatism, including gout, lumbago, and sciatica, is quite often the subject of simulation. It is feigned especially by those who wish to shirk work. The wasting of the muscles of the affected limbs in real rheumatism is absent in these cases, as is also the puffiness of the joints. Attention to the constitutional symptoms, and observing their absence in factitious cases, will be the best method of arriving at a correct diagnosis of the case. Parker states that "lumbago, which is frequently practised, is likely to yield to heroic treatment in the shape of minute incisions, or of hypodermatic injections in the region of the complaint."

Scrofula—Scurvy.—These conditions are seldom simulated. In some instances, however, ulcers have been made artificially by the use of acids. Feigned scurvy "seldom advances to a further degree than to induce a bleeding state of the gums by artificial means." (Parker.) The patient should be subjected to a rigid examination. The general scrofulous ulcer cannot be simulated.

Ulcers.—Œdema of the extremities has been feigned by placing a ligature about the part. *Ulceration* has been occasioned by such irritant substances as cantharides, lime, etc. A piece of spleen has also been glued to the parts for purposes of simulation. These should be examined uncovered. All such ulcers heal readily. (*Vide* Diseases of the Ear.)

Swelling of the Limbs.—(*Vide* Ulcers, etc.)

Venereal Diseases.—"This class of affections is rarely simulated, except for purposes of black-mail. Gonorrhœa has been stated to have been simulated by the use of caustics. Artificial irritation of the genitalia to produce eruptions has been attempted by women for purposes of fraud or to excite pity. Soldiers and sailors occasionally make use of the knowledge acquired through personal experience to simulate venereal diseases, in order to obtain discharge from the service, or to escape hazardous service, marching, or other duties. We have frequently seen a wagon-load of soldiers ex-

used from marching with the command on account of venereal disease, and very often a considerable per cent. of these cases are simulated, and succeed in escaping detection." [1]

(The above list of diseases, etc., comprises those which are most commonly feigned. For other simulations the reader is referred to the following paragraphs.)

Factitious and Fictitious Wounds.—Pretended injuries or wounds are inflicted by the malingerer for the purpose of exciting sympathy, or, in the case of soldiers and sailors, to secure their discharge from active service. These latter are adepts, and often display the most wonderful ingenuity in furthering their deceptions. One of the most extraordinary cases of self-mutilation was that of Whittaker, the colored cadet of West Point. Reese states [2] that his case affords an illustration of self-inflicted wounds, along with affected unconsciousness, for the purpose of carrying out a certain scheme. This youth had repeatedly failed in his studies, and upon the eve of his examination, which would most probably have resulted in his suspension, he made a desperate attempt to excite the sympathy of the community, as well as to gain time for study. One morning he was found in his sleeping-room, apparently unconscious, and tied to his bed with strips of muslin. There were several slight cuts, one on the ear and another across the toe. He continued apparently unconscious of all surroundings for some time, when he opened his eyes in a stupid condition. His story was that he had been surprised several hours before by a band of masked men, who felled him to the floor, and who, after wounding and threatening him, left the room. Numerous circumstances showed that the whole thing was an imposture, and on trial he was found guilty, but his sentence was modified."

The writer is familiar with a case which occurred some twelve years ago, where one man was stabbed by another, and the latter, to make it appear as if he had done the injury in self-defence, removed his own coat and fired two bullets through the sleeve, and one close to the forearm, after having rolled up his shirt-sleeve. This latter shot singed the hair and abraded the skin of the arm. (Malloy case.)

In the diagnosis of these cases it will be noticed that, as a rule, the injuries are superficial and not of a dangerous character; and, as Reese states, "the cuts and stabs made in the garments will often be found not to correspond with those made on the body. It sometimes happens that slight and trivial injuries, received in a railway or other collision, are magnified purposely, in order to obtain larger damages in a suit at law. Again, persons who have unsuccessfully attempted to commit suicide are apt, from motives of shame or disappointment, to attribute their wounds to another. In such cases the injuries are superficial, made usually by the right hand and in front, while the hands themselves are seldom wounded; in a real assault the hands are very apt to be cut and maimed." (*Vide* Wounds.)

[1] Parker, op. cit., p. 718. [2] Op. cit., p. 478.

Conditions other than Diseases that are simulated.—*Abstinence.*—This is frequently feigned for the accumulation of gain by exciting the sympathy of on-lookers. Parker says,[1] "We often meet with, in private practice, cases where young unmarried people pretend to exhibit profound grief by abstinence from food." The simulation of abstinence is very difficult to detect. The medical examiner and others should inaugurate a system of careful surveillance of the subject.

Amputations.—Of these Parker says, "We occasionally find malingerers assuming either loss of an arm or a leg as an excuse for begging. By careful wadding and the use of a canvas jacket an arm is sometimes successfully concealed. It is more difficult to assume amputation of the leg. Factitious amputations are occasionally observed where malingerers have removed a finger or toe with a hatchet or a knife. Such extraordinary instances of self-mutilation are not absolutely uncommon. While resident among many tribes of our North American Indians I have seen instances of self-mutilation where the only gratification could be that of pride. The unsightly wounds and scars of the German student-duellists can be accounted for only by this theory. The self-mutilation of religious devotees extends back to the earliest times."[2]

Aphonia is very rarely feigned, notwithstanding the ease with which it can be done. The best means of detecting the fraud is by the use of anæsthetics; or, the deceiver may be suddenly awakened from a deep sleep, when he will very likely make an exclamation.

Deafness and Dumbness.—These afflictions are, as a rule, assumed by impostors, with grossly exaggerated symptoms, so as readily to bring about the detection of the imposition. They generally lose their hearing suddenly, whereas in the real affection the trouble becomes manifest only by gradual stages. The gestures and expression of countenance of the deaf and dumb are hard to imitate. (Tanner.) Deafness has been produced by the insertion of bodies within the ear. To detect the fraud examine the ear. "Deaf people require you to speak slowly and distinctly; impostors only demand that you shout when addressing them. Place the patient under the influence of an anæsthetic; during its exhibition, or as its effects are going off, the impostor will in all probability declare himself." (Tanner.)

Deformities.—Those most frequently assumed are contractions of the fingers, elbow-, ankle-, and knee-joints. Impostors may also assume shortness or distortion of a limb, inversion of the feet, curvature of the spine, etc. Tanner mentions the case of a prisoner who shirked his work by keeping his right knee in a state of flexion for the entire period of his confinement (seven years). At the time of his discharge he impudently remarked, "I will try to put down my leg; it may be of use to me now." His remark was followed by the successful accomplishment of the act, and he walked with a firm step. Serious swellings, etc., have been produced by females

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[1] Op. cit. [2] Op. cit., p. 705.

y the insertion of numerous needles into the parts. Tanner gives the fol- owing directions for detecting the fraud. "For pretended contractions of he muscles or joints a tourniquet should be affixed above the affected part nd tightened to an extent sufficient to render the muscles incapable of act- ng ; the joint will then be found easily movable. In the same way factitious hortening of a limb from any cause may be detected, or the limb may be traightened while the impostor's attention is withdrawn, or while he is under he influence of chloroform."

Death.—"Every student of physiology will remember the case of the fficer who was able at will to arrest the action of the heart. Some people ossess this power, and to excite pity or for other fraudulent reasons will retend death. Methods recommended for the detection of apoplexy are vailable in this connection."[1] Tanner[2] says death is characterized "by he deficiency of the respiratory movements, the cessation of the motions f the heart, and by the complete loss of tone and irritability. In doubtful ases, therefore, hold a fine feather or the flame of a candle before the nose nd mouth, auscultate the heart, and try if blood will flow on opening a vein. rritants, moreover, will not redden the skin in the dead." (*Vide* Signs of Death.)

Pretended Delivery.—This has been simulated for the purpose of extort- ng money, compelling marriage, or disinheriting parties who have claims o an estate. The external genitalia are usually moistened with borrowed lood, and the child of another substituted as the woman's own. The mode f detection consists in making a proper medical examination of the parts hortly after the alleged delivery. The character of the lochia should be carefully investigated.

Dyspnœa.—This is rarely simulated. To detect the simulation the pa- tient should be carefully watched when asleep.

Delirium is sometimes feigned, and is most frequently observed in hys- terical subjects.

Involuntary Stools.—Of these Parker states, "If an examination is made of the sphincter ani muscle and the contraction is found to be normal, we should suspect malingering in those cases where it is claimed that the pas- sages are involuntary. In children the presence of intestinal worms often excites contractions, inducing emptying of the rectum. These movements have the nature of being involuntary. Such cases require kind and sensible attendance. For the genuine malingerer a diet of solid food should be pro- vided, and, as far as possible, one likely to be constipating. This, with a liberal dosing of opium and the watchful care of an intelligent attendant, will usually unmask the imposition. The passing of solid stools in the bed should be quickly and severely punished."[3]

Menstruation is simulated by staining the linen, napkins, etc., with bor- rowed blood. The genitalia are also stained in a similar way. In these

[1] Parker, op. cit., p. 708. [2] Op. cit., p. 130. [3] Op. cit.

cases of deception cutting off the supply will suffice to detect the imposition.

Pain.—Reese states[1] that "there is probably no symptom so commonly complained of by the malingerer, and none more difficult to determine by the examiner, than pain, because it is purely a subjective symptom. Hence it will try the skill and tact of the physician to the utmost. A close and patient investigation will, however, usually detect the fraud."

Bloody Urine.—This deception is accomplished by adding blood to the excretion. (*Vide* Jaundice.)

Malingering of Railway Injuries.—The following account is taken from Page's "Railway Injuries." "'Is the condition before us real or feigned?' is a question which we have sometimes to ask ourselves in the routine of practice. A correct answer to it is obviously of great moment to both doctor and patient; and I propose, therefore, to say something on the special kind of malingering which may be met with after the injuries, or after no injuries, received in railway accidents. It may be well, however, in the first place, to name some of the points which have to be borne in mind in the endeavor to come to a right conclusion, that we may decide whether the signs of disease before us be real or assumed, or the complaints we hear be genuine or the outcome of wilful exaggeration; whether, indeed, to adopt the classification of Ogston, the disease be feigned, factitious, exaggerated, or aggravated. It is a common experience that most feigned disorders have in them some basis of reality, or some revival of the symptoms of a former lesion or injury used again for purposes of deception. Familiarity with the phenomena and history of disease can alone, therefore, enable a man to pronounce with certainty as to the real nature of any particular disorder, and to detect the mistakes into which malingerers so often fall. An apt illustration may be taken from the attitude and position of the joints in real and assumed disease. By his loud complaints a man may wish to suggest the presence of destructive mischief in a joint, but in all probability he will go wrong in the attitude and position which he gives to his limb. Or, without pretending to be afflicted with actual joint-disease, a patient will sometimes affirm that a joint has become stiff, and that it is impossible to move his arm or leg. It is unnecessary to make any mention here of the recognized causes of stiffness and ankylosis of joints; suffice it that the entire absence of them, both in the history of the case and in the course of the disease, will reveal a flaw in the evidence sufficient to raise suspicion. Suspicion grows into tolerable certainty if you are careful to observe the conduct of the person under examination.

"A man complained that he could not work because of stiffness in the right elbow and inability to straighten his arm. He said he had fallen on his elbow a month ago, but it was clear from answers to his questions that the injury had not been at all severe. Comparison of the two elbow-joints showed an entire absence of physical signs, and there was no wasting of the

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[1] Op. cit.

limb. Noticing, in examination, that attempts to flex or extend his arm were forcibly resisted, he was told to look in the opposite direction, questions were asked him unconnected with his arm, and there was no difficulty in bringing it at once to natural and full extension. A turn of his head and eyes toward the affected limb was immediately followed by active flexion to the original degree. Complete flexion could also be produced under like circumstances. Examination of both arms simultaneously seemed to confuse im, for he called out with pain when pressure was made on the sound limb. uch inconsistencies as are met with here ought, at any rate, to place us on uard. A man based a large demand for compensation from a railway comany on stiffness of his elbow and inability to move his arm, the result of a ollision. A verdict incommensurate with his expectations having been reorded, he threw up his arms and exclaimed, 'My God! I'm a ruined man.'

"Furthermore, an impostor may adopt devices to produce conditions hich, in themselves alarming, are yet seen to be without significance when very feature of the case is examined. A prisoner took to his bed comlaining of great pain and swelling of the abdomen. Although the belly as enormously distended and tympanitic, there was no other sign of illness bout him, and there was an entire absence of any one condition on which mpanites usually depends. After a few days' observation, and after carelly weighing all the facts of the case, the surgeon came to the conclusion hat the man purposely distended himself by swallowing air. Loudly enough r the prisoner to hear him, he accordingly remarked to the warden, 'When come to-morrow I shall bring an instrument to tap him.' On the morrow he tympanites had disappeared. More common are the cases where patients ssure you that they are losing blood in large quantities from the bowel. The causes of hemorrhage from the bowel are well known, although an exact diagnosis may be sometimes difficult because of their very number and variety. The malingerer, however, does not know that profuse hemorrhage —and it is of profuse hemorrhage of which he invariably complains—gives rise to well-defined symptoms due to loss of blood. Who ever saw a patient losing blood, either in alarming quantities or in small amounts spread over a long time, with a florid lip, a tranquil pulse, a cool skin? Should not the presence of every indication of health warn us that we have to deal with something altogether unusual? Should we be doing rightly if we paid little or no attention to the general condition of the patient, and endeavored to estimate his case by simply hearing the story he told us, without examining the blood which he showed? By neglect of such simple precautions an erroneous diagnosis was made of a case where pints of blood, not the man's own, were presented as having been passed per rectum; and the same thing happened in another case where a man showed, from the same supposed source, prodigious quantities of 'blood and corruption.' Both were cases of imposition—subsequently known and proved—after railway accidents; and yet in both of them the fraud was successful. Surely when conditions such as these occur alone, when there is neither discoverable cause nor the usual inevi-

table result, one ought to be able to say of them at once, 'Impossible, untrue!'

"In the same category it is not amiss to refer to dilatation of pupil induced by the use of atropine, a point of some importance, because it has been shown in a previous chapter that a wide, sluggish pupil is a valuable sign of loss of nerve tone. 'The access to atropine or belladonna,' says Mr. Hutchinson, 'on the part of the public is now so easy that we cannot be surprised that we encounter mydriasis as the result of an accidental and perhaps unknown use of this agent or of its use with intention to deceive. It is the first question which will occur to the surgeon on seeing a dilated pupil, "Has atropine been used?" and he must be on his guard in cases of hasty denial. . . . Not infrequently the ophthalmic surgeon has to encounter cases of intentional deception. These occur usually in young women of emotional tendencies. . . . A highly cultivated young lady consulted me for "pemphigus." She had blebs all over the left of her body. But these blebs were, some of them, not round but oblong, in a style which no skin-disease ever assumes, and very obviously the result of the application of a brush. She was liable, I was told, to attacks of dilatation of the pupils and loss of ability to read. These attacks usually lasted a week. This case is only an example of what has frequently come under my notice. Although it is possible to use atropine in such a weak solution that the ciliary muscle is not affected, yet in most of these cases a more complete effect is obtained, and the loss of power to read is produced in addition to mydriasis. If the latter be present alone, and if it persist for long, the suspicion of deception may be put aside.' In all cases where the use of atropine is suspected it is essential to examine the patient frequently, and carefully look for some concomitant and confirmatory symptom of nerve disturbance. The pupils, moreover, it need hardly be said, must be examined both in light and shade; and it should be borne in mind that where there is inequality of the two pupils, the dilated pupil need not necessarily be the one affected. The pupil which is the smaller of the two may, for example, be unable to dilate, and be the one really at fault, because of sympathetic paralysis, a condition of things by no means unknown after organic injury to the lower cervical spine. The question might here arise whether eserine had been used, but I am not aware that eserine can induce the other signs of sympathetic paralysis,—shrinkage of the globe and contraction of the palpebral fissure.

"Let it not, moreover, be forgotten that any kind of old injury, deformity, or want of perfect symmetry may provide the malingerer with the opportunity for the practice of imposture. Hydroceles, varicoceles, and herniæ; fatty tumors, sloughing gummata, and sebaceous cysts; distended bursæ and ankylosed joints from long-past disease are some of the conditions which in my own experience have been attempted to be palmed off as the result of railway shock. No man who knows his business can be taken in by such things as these. Great care, however, must be always exercised in the examination and estimation of abnormal conditions which may

resented, that no injustice may be done a man in coming to a hasty lusion that he is malingering. It is singular, for example, how ignorant persons seem to be of the existence of deformities or states of body h must have been endured for a long time."

he Simulation of Disease by Children.—According to Dufesnel,[1] is quite common in schools, asylums, etc., for the purpose of escaping disagreeable duty. He divides these children into three groups: st, those who feign some simple indisposition with a definite object, and are otherwise normally constituted; second, children who pretend to be ing from more complicated diseases, who present usually an hered- history of nervous affections, and who are not well balanced men- and, third, hysterical malingerers. It is in dealing with the second of cases that the physician is most likely to be led astray in his diag- and to believe that he has a real malady to contend with. These chil- as before stated, have a neuropathic family history, and they have also badly brought up, their every whim being yielded to by over-indulgent ts. These precocious malingerers are more often girls than boys, in roportion of nearly two to one. They are more frequently from eleven een years of age, though cases are not uncommon in children of more r years. The author was unable to learn of any recorded instance of ation in children under four years of age.

In the diagnosis of simulated diseases in children, the author calls tion especially to two points. The physician should be on his guard ever the little patient's story of his illness is too monotonous. One is really ill tells a different tale from day to day, his pain and his feelings modified by passing circumstances. The malingerer, on the other , has his story learned by heart, and repeats it always without modifica- . Another thing that should excite suspicion in the physician's mind long duration of the simulated malady and a want of proportion between hysical signs and the degree of pain or discomfort of which the child lains. The treatment of the little malingerer should consist rather in reatment of the parents. The physician should not at once announce he child is shamming, for the only result of such a course will ordinarily at the child will pass out from under his care. But he should so man- he case that the deception will become apparent to the attendants. , M. Dufesnel thinks, and probably very justly, when the parents are persuaded that the child is deceiving them, there will not be much time d in completing the cure. Parental discipline is the most potent dy for infantile malingering."[2]

[1] The Simulated Diseases of Childhood, Thèse de Paris, 1888.

[2] Medical Record, New York, July 14, 1888, vol. xxxiv. p. 43, No. 2.

CHAPTER XL.

LEGITIMACY—INHERITANCE.[1]

Medico-Legal Relations—Ordinary and Protracted Gestation—Premature Deliver Early Viability of the Child—Live Birth in Civil Cases—Tenancy by Courtes Laws Relative to Legitimacy—Paternity—Affiliation.

CASES involving the questions of **legitimacy** and **inheritance** are of surrounded by great difficulties, on account of the uncertainty of the e dence advanced by the medical expert alone. They are seldom decided such testimony, the evidence required to prove that an infant is the offspr of illicit intercourse being of a different character, with which the le physician is not concerned. The medico-legal questions that do, howev concern him are those of protracted human gestation and of premature livery. Their bearing in relation to legitimacy and inheritance will be c sidered later.

The law assumes that every child born in wedlock, or within a cert period subsequent to the demise of the husband in accordance with natural duration of pregnancy, is legitimate,—in other words, it is presun to have the mother's husband for its father. The paternity may, howev be disputed upon certain grounds, as (1) where the husband and wife h been separated for a certain time beyond the usually allotted period of pr nancy; (2) where there is absolute impotence on the part of the husba during the same period; (3) where the woman has committed adultery, the child has been repudiated by the husband; (4) when the woman was well advanced in pregnancy at the time of her marriage that her condit must have been plainly evident to her husband, this will be deemed a recognition of paternity, and also of legitimacy, on his part. It appears t a child born subsequent to the death of its mother, provided she be leg married, is a legitimate one. (Reese.)

Ordinary and Protracted Gestation.—What is the natural period gestation? The usual period of utero-gestation is about nine calendar ten lunar months, forty weeks or two hundred and eighty days. Consic able variation of this period is observed in different women. Wharton Stillé[2] say, "The idea has of late years been put forward and sustained direct observation that in women whose menstrual function is regular, ge tion will terminate at the tenth menstrual period after that upon which c ception has ensued. Thus, as the ordinary menstrual interval is ab twenty-eight days, the ordinary duration of pregnancy would be a few d

[1] *Vide* Impotence, Sterility, etc.

[2] Medical Jurisprudence.

ess than two hundred and eighty days, varying according to the time occupied by the monthly flow. On this principle the apparent difference among women in the length of their pregnancies might be explained by reference to the well-known variations in the length of the intermenstrual periods, protracted gestation occurring in those having a menstrual interval naturally of more than twenty-eight days, and apparently premature confinements in those who menstruate at shorter intervals. The successful establishment of such a law would afford striking confirmation of the general truth of a popular belief reposing upon ages of experience. The greater tendency to abortion or premature delivery at the recurrence of the menstrual epochs, and the usual re-establishment of the menstrual function within one month after parturition, in case the woman does not suckle her child, afford a presumption in favor of its correctness. Nevertheless, much additional and careful observation is required before we can be permitted to base a positive opinion in legal cases on such a mode of calculation." The variation referred to may, however, be more apparent than real, as it is frequently very difficult to determine a fixed starting-point,—*i.e.*, the date of conception. The latter is usually calculated from (1) the peculiar sensations experienced by females at conception, although this is altogether ill-defined and scarcely reliable, as conception may take place in the unconscious state; (2) the cessation of menstruation, which may be regarded as the best method of calculating, although the arrest of the catamenia may be caused by other circumstances, while, on the other hand, it may occur during the entire period of pregnancy;[1] (3) the period of quickening; this sign is also an uncertain one to calculate from, since it is subject to the greatest variation in different persons, and also since it may occur without pregnancy, and *vice versa;* and (4) a single coitus, which is the most certain starting-point from which to determine the date of conception; but even here, "where this can be accurately settled, still there will be found considerable discrepancies which must be attributed to individual peculiarities, and which indicate that there is no absolute law on the subject." (Reese.)

In Com. *vs.* Hoover, 3 Clark (Pa.), 524, the court charged the jury as follows. "The defendant is indicted for fornication and bastardy. The prosecutrix is a competent witness, but her credibility is for the jury. According to her account, the child was begotten on March 23, 1845. It was born on January 30, 1846, a male, fine, large, and healthy. The period of gestation was three hundred and thirteen days. It is conceded that the defendant had no intercourse with the mother after the 23d of March, 1845, and that the time of delivery is fixed with equal certainty. A question of science has arisen respecting the possibility of protracted gestation. The

[1] Other fallacies are: the cessation of the catamenia previous to the time of conception; their arrest by cold at one monthly period, so that conception might occur before the next period, and thus a mistake in the calculation may take in several days, or even a month, etc.

usual period is nine calendar months, or from two hundred and seventy-three to two hundred and seventy-five days. What has been denominated as the extreme of the usual period is two hundred and eighty days, or ten lunar months. But whether any, and, if any, what, longer time may be allowed as possible are the questions which the case presents for decision. Medical writers of celebrity and authority are arranged on both sides of these questions, and the medical witnesses upon the stand are, in like manner, divided in opinion. In construing this evidence, so far as respects the facts narrated by each, it is proper to consider that writers and witnesses are respectively relating only the results of their own knowledge; and when one states that no case of protracted gestation has fallen under his observation, it is but negative testimony, and cannot justly be relied upon to invalidate the affirmative evidence of others, equally entitled to credit, who can enumerate cases of the kind which they positively affirm to have come within the range of their practice and knowledge. . . . One gentleman, in a long course of practice, may have failed to observe any case of the kind. Another, in a very brief period, may have noticed several, and it is reasonable to believe that when such a diversity of opinion exists, each will be in some measure influenced by his own professional experience, and that this will also, to some extent, affect his belief in the cases reported by others. There are doubtless many of these cases where the struggle for character and property, and the circumstances of the parties whose interests have been involved, have furnished temptations to falsify, and may have influenced the decisions of the tribunals. But, after making all proper allowances for cases of this description, the whole evidence on the question, where fairly considered, appears to show that cases of protracted gestation are not impossible, although their existence is very unusual. The heads of wheat in the same field do not all ripen together. The ears of corn on the same stalk do not all come to maturity at the same time. Even the grains of corn on the same ear ripen at different intervals. The fruit on the same tree shows the like deviation; a portion will ripen and fall, while other portions remain comparatively green upon the parent stalk. The eggs of the fowl, under process of incubation at the same time, are subject to the same variation. In quadrupeds, if the testimony of Mr. Tessler be believed, we have proof of the like irregularity. Whatever may be the causes operating in each case to divert nature from her accustomed course, to accelerate or delay her usual progress, the human species, like the rest of creation, seems occasionally under their influences. The developments of puberty, although generally shown at a certain age, are far from regular. Some individuals approach it earlier, others later, in life.

"Intellectual maturity is subject to the same irregularities. Some are precocious, others astonishingly tardy in arriving at the usual degree of discretion. The intervals between catamenial visits, although in general regular and fixed, exhibit remarkable deviations. The final departure of the catamenia, although generally to be expected at a certain age, is as irregular as

their first approach, and as subject to variation as were their periodical returns. A certain period of life has usually been assigned for the termination of a mother's perils, but the instances of extensive deviations from this general rule are numerous and well established. The gestation of one child at a time is according to the usual course of nature, but the births of twins, triplets, etc., furnish indubitable proofs of astonishing departure from the usual course. The sensations of the mother produced by the elevation of the fœtus from the cavity of the pelvis, called quickening, although usually occurring at a certain period, are known to be subject to the like departure from the usual time. . . . From analogy, and from the statements of distinguished authors and eminent witnesses, after making every allowance for mistakes and the operation of unfavorable influences, we are led to the belief that, although nature delights in adhering to her general usages, she is occasionally retarded in her progress and otherwise coerced, by causes not always apparent, into extensive deviations from her accustomed path. And we are induced to believe that protracted gestation for the period of three hundred and thirteen days, although unusual and improbable, is not impossible. The evidence to establish the existence of such a considerable departure from the usual period should be clear and free from doubt. The witness should possess a character beyond reproach, and her testimony should be consistent and uncontradicted in all material facts. If the jury are satisfied that the evidence for the commonwealth is of this character, the unusually long period of gestation does not require them to disregard it. The law fixes no period as the *ultimum tempus pariendi*. The usual period has been stated, but longer time may be allowed, according to the opinions of physicians and the circumstances of the case." The jury found the defendant guilty.[1]

Dr. L. A. Rodenstein, of New York, who reported four cases of prolonged gestation, says[2] "that the number of cases cited upon undoubted authority by every writer on obstetrics, and the cases constantly reported as occurring under the personal observation of general practitioners, go to show that prolonged gestation is not a myth, and especially that it should not be explained away by questioning the virtue of the mother. How long the duration of the period of gestation can extend beyond the normal time is not yet determined, perhaps cannot be determined, but that it may extend over two months is apparently settled. The same principle is involved, whether the uterus tolerates the presence of the child three days or one hundred and forty-five days[3] after the natural time of gestation has expired. He believes that after the uterus has performed its physiological function of gestation for the natural term, it rests from the work of gestation proper. Why does it not, then, exercise the function of expulsion? That question

[1] American and English Encyclopædia of Law, vol. xv. p. 213.
[2] New York Medical Journal and Obstetrical Review, May, 1882.
[3] Professor Meigs's Report.

he does not attempt to answer, but believes that after gestation has performed its proper and peculiar work the growth of the child is complete, and it thereafter lies dormant in the womb. Otherwise the child would grow to huge size, and its delivery in the natural way would be impossible; whereas, in the cases cited the size of the child at the expiration of the period of prolonged gestation was normal."[1]

The following abstract of the celebrated *Gardner Peerage case*, before the House of Lords, is taken from Taylor's "Medical Jurisprudence." It affords illustration of many of the disputed points relative to the subject of legitimacy. "Alan Lagge Gardner, the son of Lord Gardner by his second wife, petitioned to have his name inscribed as a peer of the Parliament roll. The peerage was, however, claimed by another person, Henry Fenton Jades, who alleged that he was the son of Lord Gardner by his first and subsequently divorced wife. It was contended that the latter was illegitimate; and in order to establish this point the evidence adduced was partly medical and partly moral. Lady Gardner, the mother of the alleged illegitimate child, parted from her husband on board of his ship, on the 30th of January, 1802. Lord Gardner went to the West Indies, and did not again see his wife until the 11th of July following. The child whose legitimacy was disputed was born on the 8th of December of that year. Therefore, the plain medical question, taking the extreme view, was whether a child born three hundred and eleven days (forty-four weeks and three days) after intercourse (from January to December), or one hundred and fifty days (twenty-one weeks and three days) from July to December, could be considered to be the child of Lord Gardner. If the question were answered in the affirmative, then it followed that this must have been a very premature or a very protracted birth. There was no pretence that this was a premature case, the child having been mature when born. The question, then, was reduced to this, Was this alleged protracted gestation consistent with medical experience? Many medical witnesses, comprising the principal obstetric practitioners in the kingdom, were examined on this point. Their evidence was very conflicting, but a large majority concurred in the opinion that natural gestation might be protracted to a period which would cover the birth of the alleged illegitimate child. On the moral side of the question, it was clearly proved that Lady Gardner, after the departure of her husband, was living in open adulterous intercourse with a Mr. Jades, and on this ground Lord Gardner obtained a divorce from her after his return. It was contended that the counter-claimant was really the son of Lady Gardner by Mr. Jades. The decision of the House was that this claimant was illegitimate, and that the title should descend to the son of the second Lady Gardner."

It is important to recollect in connection with this subject that the date of conception is not always synchronous with intercourse or insemination. Bischoff and Valentine have shown that the spermatozoa may retain their

[1] Medical News, May 20, 1882.

vitality for several days after sexual intercourse before conception takes place. Fecundation cannot result until the spermatozoa come into contact with a matured ovum; and as the time occupied by the descent of the ovum is subject to variation, conception might be delayed for as long a period as seven days. Taylor[1] says that this does not satisfactorily explain such extreme differences as are alluded to above. "We must, therefore, be prepared to admit either that conception in some cases may be delayed for so long a period as from five to seven weeks after intercourse, or that there may be this great difference in the duration of pregnancy. Whatever may be the explanation adopted, it is obvious that, in a medico-legal view, the only conclusion at which we can arrive is that the period of gestation in the human female is not, as it was formerly supposed to be, a fixed and invariable term."

Premature Delivery.—An important question touching upon legitimacy is whether a fully developed child can be born before the ordinary period of gestation. For example, a husband returns to his wife after being separated from her for some time, say two years. After their reunion, and after a period of seven months or a little more, a fully developed child is born. *Is this a legitimate child?* This is a question which presents difficulties almost as great as does that of protracted gestation. There can be no doubt that children are born at the seventh month of gestation who are capable of living, although they are, as a rule, more delicate than those born at full term. On the other hand, some women always give birth to premature children; but in these cases some pathologic condition must be the cause of the early emptying of the uterus. It must be admitted that full-term children are subject to considerable variation in length, in weight, and in apparent maturity, so that some births at eight months are apparently better developed than some full-term children. Such instances are, of course, the exception and not the rule.

"Hodge and Spiegelberg both taught that strong and vigorous children might be delivered before the completion of the nine months of gestation. It is the belief of the writer that in a given case, where pregnancy has continued to within two or three (or possibly four) weeks of its completion, there may be some doubt whether the child born at that time be a full-term one or not, on account of the advanced stage of its development."[2] Montgomery, of Philadelphia, states that he never observed a child of seven months' gestation present even the remotest appearance of the well-developed child of full term. These children are, as mentioned above, much more delicate, and require greater care and attention to preserve them. Reese states[3] "that, while in some instances there may be a doubt about an eight months'

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[1] Op. cit.

[2] Edgar, in Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. ii. p. 277.

[3] Op. cit.

child, on account of its advanced degree of development, there ought to be no doubt whatever in the case of a six or seven months' child."

Viability.—The earliest period at which an infant may be born alive is generally admitted to be eight months, although even a seven months' child may live. Cases are on record where a six months' infant, and even earlier, has survived, but such instances are extremely rare. As a rule, medical authorities do not consider an infant viable until it has reached the end of the seventh lunar month of intra-uterine life. An infant born earlier than a little over five months could not be considered viable. (Reese.)

Live Birth in Civil Cases.—Reese states that the question of premature birth may present itself under another aspect, of a civil nature,—viz., that of survivorship, where a living child acquires civil rights, such as inheritance and the transmission of property. In such a case it becomes a matter of vital importance to establish the fact that the child, when born, was actually alive. The laws of this country and of England do not require that the child should be viable,—*i.e.*, capable of continuing to live,—but only that it should be born alive. It matters not whether it be mature or immature, so that it was alive. What, then, constitutes a live birth? We reply, anything that will prove that the child was living at the time of its birth. According to the laws of the United States and of England, neither breathing nor crying is essential to establish a live birth; the pulsation of the child's heart, or of one of its arteries, or the slightest voluntary movement, is regarded as sufficient for this purpose. In Scotland crying is regarded essential, in France respiration, and in Germany crying, attested by unimpeachable witnesses. According to Blackstone, crying, indeed, is the strongest evidence, but it is not the only evidence; and Coke remarks, "If it be born alive, it is sufficient, though it be not heard to cry, for peradventure it may be born dumb."

"With this clear and definite understanding of what is legally regarded as the proofs of a live birth, we must admit that fœtuses have been born alive as early as four months, and, of course, at all periods of a later date. Such a case is reported by Dr. Erbkam, of Berlin, when the fœtus was only six inches long and weighed but eight ounces; it survived half an hour; it moved its legs and arms, turned its head from side to side, and opened its mouth. Müller pronounced this fœtus to be not over four months old. Dr. Barrows, of Hartford, reports another case, especially interesting from the fact that the exact period of conception could be fixed; miscarriage took place at one hundred and forty-four days,—less than five calendar months. The ovum was expelled entire. Before the rupture of the membranes the movements of the child were vigorous. After the rupture it cried out very distinctly; the cord was tied on ceasing to pulsate, after which it breathed with a gasp for forty minutes; it repeatedly opened its mouth and thrust out its tongue. It measured ten inches long and weighed fourteen ounces."[1]

[1] Op. cit., p. 552.

Tenancy by Courtesy.—According to Blackstone, this phrase signifies tenant by the courts of England. It is a mode of inheritance such as follows. If a married woman seized of an estate of inheritance dies, the husband acquires a life-interest in it, provided a living child has been born of the marriage during the life of the wife. In such cases the medical examiner may be summoned to determine not only the live birth of the child but also that it was capable of inheritance.[1] If there be no living issue of the marriage, the inheritance or estate passes from the husband to the heir-at-law. If the child be born after the death of the mother (Cæsarean section), it could not transmit an inheritance. "Lord Coke and most legal authorities quote a case that occurred three centuries ago, which was decided against the husband on the ground that the child was extracted by Cæsarean operation after the mother was dead. It is possible, now this operation on both living and dead women has become of somewhat frequent occurrence, that this decision might be reversed, more especially seeing that a child thus born is declared to be legitimate, although death had dissolved the marriage before birth. It might prove a curious matter for discussion, altogether apart from this question, whether extraction by Cæsarean operation can legally be called *birth*."[2]

Laws Relative to Legitimacy.[3]—*How established or proved.*—Parentage may be established at law, and can only, in general, be so established as regards the father by a combination of facts indicating the connection of the parent and the child, between an individual and the family to which he claims to belong. Among the principal of these facts are that his mother was married to the person whom he claims as his father at the time he was born or begotten; that he has always borne his name and been treated and maintained and educated as his child; that he has been uniformly received

[1] A monster cannot inherit or transmit a property. On this question Tidy (*op. cit.*) says, "A consideration of the recorded cases and of the specimens in our museums justifies the assertion that none of the so-called human monsters that have lived to adult age can be denied human shape. This, however, can scarcely be so positively stated in the case of certain human births where there has been distinct evidence of life for a brief period only. Still, it would, in our judgment, constitute an almost unrecorded case where the jurist would be justified in saying, without reserve, that a child born alive had not the shape of mankind, implying as the phrase does far more than mere deformity. Hideous as the appearance presented by an encephalic (without brains) monster is, curious as are the so-called human sirens or dolphins (that is, children where the lower legs are completely united), and inhuman-looking as certain microcephalic (ape-like) and pig-faced children may appear, the medical jurist should, even in such cases, hesitate before he asserts positively that they lack human shape. We repeat that in such births, involving questions of law, it is better for the medical witnesses to describe to the court the exact deformity, and leave the responsibility of deciding whether it be a monster in the true legal sense to others." Reese (*op. cit.*) says, "It is difficult to say how such a ruling would apply as to the exclusion of such cases as the *Siamese twins* and others somewhat similar."

[2] Tidy's Legal Medicine, vol. iii. p. 152.

[3] American and English Encyclopædia of Law, vol. xiii. p. 226.

as such in society, and that he has been acknowledged as such by the family. These things being shown, his *legitimacy* is presumed. (J. D. Lawson in 15 Cen. Law Jour., p. 262, *citing* Weatherford *vs.* Weatherford, 20 Ala. 548; Illinois Loan Co. *vs.* Bonner, 75 Ill. 315; Barnum *vs.* Barnum, 42 Eng. 253. Where a man speaks of a child as his daughter, the presumption is that she is legitimate. Gaines *vs.* Herman, 24 How., U. S. 553; Gains *vs.* New Orleans, 6 Wall., U. S. 690. If the father is proved to have brought up the party as his legitimate son, this amounts to a daily assertion that the son is legitimate. Taylor on Ev., Text-Book Series, § 549; Hargrave *vs.* Hargrave, 2 C. & Kir. 701.)

"Every child in a civilized community is presumed to be legitimate where the mother was cohabited with and recognized by the father as his wife, and, in the absence of any proof to the contrary, no other evidence of a legal marriage will be necessary to legitimize the offspring. (Strode *vs.* Magowan, 2 Bush, Ky. 627.) When there has been a marriage, and husband and wife have cohabited together, and no impotency is shown, the issue is conclusively shown to be legitimate, though the wife is shown at the same time to have been guilty of infidelity. (Taylor's Ev., Text-Book Series, § 106; Hemmenway *vs.* Towner, 1 Allen, Mass. 209.) This legal presumption, that he is the father whom the nuptials show to be so, is the foundation of every man's birth and status. It is a plain and sensible maxim, which is the corner-stone, the very foundation, on which rests the whole fabric of human society; and if you allow it once to be shaken, there is no saying what consequences may follow. Routledge *vs.* Carruthers, *cited* in Nicholas on Adult. Bast. 161. By the ancient common law, if the husband was within the *four seas* at any time during the pregnancy of the wife, the presumption was conclusive that the issue was legitimate. R. *vs.* Murray, 1 Salk. 122; R. *vs.* Allerton, 1 Ld. Raym. 122. Where a child is born in lawful wedlock, the husband not being separated from his wife by a sentence of divorce, sexual intercourse is presumed to have taken place between the husband and the wife, until the presumption is encountered by such evidence as proves to the satisfaction of those who are to decide the question that such sexual intercourse did not take place at any time when by such intercourse the husband could, according to the laws of nature, be the father of the child. Banbury Peerage, answer to seventh question, 1 Sim. & Stu. 157 (1811). In the case of King *vs.* Luffe, 8 East. 207 (1807), Lord Ellenborough laid down the rule that the illegitimacy of a child might be shown where legitimacy was impossible in five cases. 1. Where the impossibility arose from the husband being under the age of puberty. 2. Where the impossibility arose from the husband laboring under a disability occasioned by natural infirmity, as in Foxcraft's case (Poll. Abr.), an infirm, bedridden man was married in that state twelve weeks before his wife bore a child. The child was adjudged illegitimate. 3. Where the impossibility arose from the length of time elapsed since the death of the husband. 4. Where the impossibility arose from the absence of the husband, as where he was outside the realm at

the time the child was begotten. *Vide* R. *vs.* Allerton, 1 Ld. Raym. 395. 5. Where the impossibility was based upon the laws of nature, as where it was attempted to charge a black man as the father of a white child born of a colored woman. *Vide* Whisterlos's case, *cited* in Cross *vs.* Cross, 3 Paige Ch. (N. Y.) 139. *Vide* Illinois Loan Co. *vs.* Bonner, 75 Ill. 315. . . . The ancient policy of the law of England remains unchanged. A child born of a married woman is presumed to be the child of the husband, unless there is evidence which excludes all doubt that the husband could not be the father. But in modern times the rule of evidence has varied. Formerly it was considered that all doubt could not be excluded unless the husband were *extra quatuor maria.* But as it is observed that all doubt may be excluded from other circumstances, although the husband is within the four seas, the modern practice permits the introduction of every species of legal evidence tending to the same conclusion. But still the evidence must be of the character to exclude all doubt; and when the judges in the Banbury case spoke of satisfactory evidence upon this subject, they must have meant such evidence as would be satisfactory, having regard to the special nature of the subject. Head *vs.* Head, 1 Sim. & Stu. 150 (1823), either before or after marriage. (Cross *vs.* Cross, 3 Paige Ch., N. Y. 139; 23 Am. Dec. 778.) The presumption of legitimacy may be rebutted, however, by showing that the husband was (1) incompetent; (2) entirely absent, so as to have no intercourse or communication of any kind with the mother; (3) entirely absent at the period during which the child must, in the course of nature, have been begotten; (4) only present under circumstances affording clear and satisfactory proof that there was no sexual intercourse. (Hargrove *vs.* Hargrove, 9 Beav. 255.) *Access.*—Lord Hale, in Horpell *vs.* Collins, decided that the issue for the jury was as to the fact of access, or, as I understand him to mean, sexual intercourse. For the access in question is of a peculiar nature, not being access in the ordinary acceptation of the word, but access between a husband and wife viewed with reference to the result,—namely, the procreation of children. Lord Eldon, in Banbury case, 1 Sim. & Stu. 159. By *access* I mean opportunities of having sexual intercourse. Cope *vs.* Cope, Alderson B., 1 En. & Rob. 275. Access is such access as affords an opportunity of sexual intercourse. Benry *vs.* Philpot, 2 Myl. & K. 349. . . . The absence of sexual intercourse, where there has been some society intercourse or access, has been called non-generating access. Hargrove *vs.* Hargrove, 9 Beav. 255 (1846). Access is such access as affords an opportunity of sexual intercourse, and when the fact of such access between a husband and wife within a period capable of raising the legal inference as to the legitimacy of an after-born child is not disputed, probabilities can have no weight, and the case ought never to be sent to the jury. There is nothing against the evidence of access except evidence of the adulterous intercourse of the wife with H., which does not affect the legal inference; for if it were proved that she slept every night with her paramour from the period of separation from her husband, I must still declare the children to be legitimate. The interest

of the public depends upon a strict adherence to the rule of law. Berry *vs.* Philpot, 2 Myl. & K. 349 (1834). *Vide* Morris *vs.* Davies, 5 Cl. & Fin. 243 (1837). . . . Where there is access the presumption of sexual intercourse is very strong, as is illustrated by the case of Plowes *vs.* Bossy, 31 L. J., Ch. 680 (1862). In this case, B., who was married in 1829, became a lunatic in 1833, and was confined in a lunatic asylum until his death. His wife, who lived twenty-five miles away, occasionally visited her husband, but the keepers of the asylum were under strict orders not to allow them to remain alone together. He was allowed the freedom of the grounds, and, the porter being sometimes absent, it was possible for a person to enter without being seen. In March, 1835, she visited the asylum and remained alone for some time with her husband. A child was born in December, 1835. There were rumors at the time that Mrs. B. was living in adultery with one D. But the court *held* that the child was legitimate. *Vide contra*, Clark *vs.* Maynard, 1 Madd. & G. 364 (1832). The *onus* lies on the person alleging that the child of the married woman is illegitimate to prove it. There is no onus on the party whose legitimacy is in question to show opportunities of access or what the circumstances were under which the access took place. Plowes *vs.* Bossy, 31 L. J., Ch. 680 (1862). . . . The presumption still holds where the parties are living apart by mutual consent (Hemmingway *vs.* Towner, 1 Allen, Mass. 209; Morris *vs.* Davis, 5 Cl. & Fin. 163), but not divorced. (Hemmingway *vs.* Towner, 1 Allen, Mass. 209.) Neither the evidence of the husband nor wife is admissible to prove access or non-access. (Dennison *vs.* Page, 29 Pa. St. 420; Patchett *vs.* Holgate, 15 Jur. 308; Parker *vs.* Way, 15 N. H. 45; People *vs.* Antario, 15 Barb. N. Y. 286; Kleinnart *vs.* Ehlers, 38 Pa. St. 439; State *vs.* Herman, 13 Ired., N. Car. 502; Hemmingway *vs.* Towner, 1 Allen, Mass. 209. *Vide* Wright *vs.* Hicks, 15 Ga. 160; Clapp *vs.* Clapp, 97 Mass. 531; Stegall *vs.* Stegall, 2 Brock., U. S. 256; Pendrell *vs.* Pendrell, 2 Strange, 925; Com. *vs.* Shepperd, 6 Binn., Pa. 273; Cope *vs.* Cope, 1 En. & Rob. 275; Stevens *vs.* Moss, 2 Cowp. 594. In R. *vs.* Sourton, 5 A. & E. 180, with a view of proving non-access, the father was asked whether at a particular time he did not live one hundred miles from his wife and cohabit with her sister. *Held*, that the question could not be put.) Nor are the declarations of the persons whose legitimacy is in question admissible." (Elvi *vs.* Mader, 1 Rob. 581; 38 Am. Dec. 192.)

An infant born later than ten calendar months subsequent to its father's demise was not considered legitimate under the Roman law. The legitimacy of a child is allowed by the French law if born one hundred and eighty days after marriage, and three hundred days after the death or non-access of the husband. According to the Prussian law, a child born within three hundred and two days after the husband's death is legitimate, and in Scotland legitimacy is established if the child is born one hundred and sixty-eight days after marriage, and within ten months after the death of the father. (Reese.)

Paternity—Affiliation.—The medico-legal question of *paternity* pre-

nts itself under various circumstances, as in bastardy cases and in cases here a supposititious child claims to be the heir of an estate ; or, again, where e alleged father is obliged to support the child. In such cases the family eness, although not conclusive in itself, has often been regarded by dical jurists as strong presumptive proof of paternity. This evidence, wever, requires further corroboration.[1] The resemblance to the alleged ent is determined not only by the features, but the voice, gesture, atti- e, habits, and personal deformities must also be taken into consideration. certain cases the likeness of the child to the parent may be evident by r, as, for example, where the mother gives birth to a mulatto, etc., or *versa.*

Personal deformities are not necessarily transmitted from the parent to child. Thus, a deformity in the child might have been occasioned by woman during her pregnancy being influenced by having seen a person cted with a like deformity. Such a case demonstrates how unsafe it ld be to make the decision, in a disputed question of paternity, depend ly upon likeness.

The question of paternity in the *Douglass Peerage Case* was shown by d Mansfield, in delivering the judgment in the House of Lords, to be an ortant link in the chain of evidence. He expressed a decided opinion avor of the resemblance which the claimant bore to his father. In Gil- nton *vs.* Ham, 38 N. H. 108, "both the child and the putative father e before the jury, who were permitted to draw their own inference as to emblance." In Iowa a distinction is made as to the admission of a young nt and a child two years old, in favor of the child two years old. State Smith, 54 Iowa, 104 ; 37 Am. Rep. 192. In this case the court said, child of the proper age may be exhibited to a jury as evidence of alleged ernity. Precisely what should be deemed the proper age we need not ermine. . . . A child who is only three months old has that peculiar

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[1] In Young *vs.* Makepeace, 103 Mass. 50, the defendant in a bastardy proceeding ied that he was the father of the child, but alleged that one Dean was the father. complainant then offered evidence to show dissimilarity between Dean and the d. Exceptions to the admission of the evidence were sustained, the court saying, e think, also, that the testimony to show points of the similarity between the child l Dean should not have been admitted. Even where there is a noticeable resem- nce, there may be equally marked points of dissimilarity. Points of dissimilarity, implying a difference of race, do not tend to disprove paternity. They are, at st, of much less significance than points of resemblance ; but proof of resemblance s excluded in Eddy *vs.* Gray, 4 Allen (Mass.), 435. That decision was based some- at upon one in Maine, the reasons for which were considered quite satisfactory. eniston *vs.* Rowe, 16 Me. 38.) In the latter case, however, the evidence excluded s of dissimilarity. Resemblance was held to be properly a matter of consideration the jury upon this issue in Gilmanton *vs.* Ham, 38 N. H. 108. But in that case the y had both the child and the putative father before them, and took the fact from ir own observation. . . . In People *vs.* Carney, 29 Hun (N. Y.), 47, evidence of the or of the child's eyes is not admissible to show its paternity."

immaturity of features which characterizes an infant during the time it is called a babe. A child two years old or more has to a large extent put off that peculiar immaturity. In allowing a child of that age to be exhibited, we think the court did not err." In Flannegan *vs.* Dugan, 14 Allen (Mass.), 197, the court said, "The fact of a resemblance between the child and the putative father was proper for the consideration of the jury. It is a well-known physiological fact that peculiarities of feature and personal traits are often transmitted from parent to child. Taken by itself, proof of such resemblance would be insufficient to establish the paternity; but it would be clearly a circumstance to be considered in connection with other facts tending to prove the issue on which the jury are to pass." [1]

Questions of paternity are sometimes involved in those extending to *affiliation*. For example, a female having had sexual relations with two men within a few days of each other, and giving birth to a child, one of the men is affiliated rather than the other. The difficulty of settling such a question by medical opinion cannot be denied, although its possible determination might be affected by circumstances of parental likeness, color, etc. But, as Reese states,[2] "It would seem more just and equitable that each putative father should contribute an equal share toward its support." The same authority says, relative to the question of paternity, "There is a curious physiological fact that might occasionally be supposed to affect the decision. It is known to breeders of horses and cattle that the influence of the impregnation by one sire may be extended beyond the foal begotten at the time, and affect those begotten subsequently by another sire. This is proved by the later colts or calves bearing the peculiar markings of the first sire. The question, therefore, might be suggested whether this same handing down of parental likeness to the children of a subsequent father might be possible. Without any positive data on which to venture an opinion, it may, nevertheless, be suggested here as a circumstance to be considered in certain cases of affiliation."

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[1] American and English Encyclopædia of Law, vol. xv. p. 215.

[2] Op. cit.

CHAPTER XLI.

LIFE INSURANCE.

Definition of the Term Life Insurance—Conditions of the Policy—Expectation of Life—Concealment of Facts—Intemperance in Relation to Life Insurance—Relation of Suicide to Life Insurance—The Medical Examination—Tables.

Life Insurance may be regarded simply as a contract "in which one party agrees to pay a given sum upon the happening of a particular event, contingent upon the duration of human life, in consideration of the immediate payment of a smaller sum, or certain equivalent periodical payments by another." (Bunyon.) In other words, it is a contract to pay to certain survivors a certain sum on the demise of the party whose life is insured. It may be called insurance against death.[1] The *premium* is the amount payable in a lump sum, or in yearly or half-yearly instalments, on the part of the insured to the insurers. The *policy* is the writing in which the contract of insurance is embodied. It may contain numerous provisions and conditions which are sometimes the cause of legal disputes.

The amount of premium to be paid on the part of the insured to the insurers depends principally upon the age of the applicant, although the sex and occupation of the individual are also taken into consideration. "The terms of the policy govern its duration, and these are usually definite. To entitle the beneficiary to a recovery the death must have occurred within the life of the policy as thus determined. Recovery could not be had, for instance, by reason of the fact that the insured lay in a dying condition before the expiration of the policy, if, in fact, he survived its expiration. (Howell *vs.* Knickerbocker Life Ins. Co., 44 N. Y. 268.) In some instances, however, recovery may be had for a death occurring prior to the issuing of the policy. The test is the consummation of the contract, for it is from this time the insurance runs, without regard to the time it is reduced to a formal policy. Thus, where the insured fell sick, after the application and before the policy was issued, of the disease of which he died, he having acted in good faith, it was held that, it appearing that a contract of insurance had been completed orally, the company was liable. (Southern Life Ins. Co. *vs.* Kempton, 56 Ga. 339. The fact that the insured is stricken with disease and dies soon after effecting insurance does not raise a presumption of fraud. Eclectic Life Ins. Co. *vs.* Fahrenkrug, 68 Ill. 484; Am. and Eng. Enc. of Law, 13, 630.) But the insured must be living when the contract is made. Otherwise it will be void, though dated prior to the death." (Lefavour *vs.* Ins. Co., 1 Phila., Pa., 558; *Ibid.*, p. 631.)

[1] The stipulated amount of money may be paid either to the executors or assigns of the insured person at death, or to the latter at some definite period of his life.

The amount insured for being payable only at death, the companies always insist that satisfactory proof of the death of the insured be made before the heirs can lay claim to the inheritance. In cases of individuals who have disappeared, as where an insured party went to sea and was never heard of again, the law permits the lapse of seven years (presumption of death) before payment of the amount insured for can be pressed. In some instances the insurance company pays the amount before this period, provided there is no reason to suspect fraud. The question of presumption may also be raised in cases where two or more individuals are lost by disaster at sea, etc. Here, if one of the persons happens to be insured for the benefit of the other, the question arises, Which one is presumed to be the survivor? (*Vide* Presumption of Survivorship.)

Conditions of the Policy.—The question as to the general health of the applicant, as influencing his expectation of life, is one of the most important conditions of the policy. Here it is that the medical man is brought into relation with the insurance companies. (*Vide* paragraphs on the Medical Examination of the Applicant.) "A common warrantee is that the insured is in 'good health.' So used, the words mean nothing more nor less than what they usually and commonly mean, and it is for the jury to say whether or not the party was in good health at the time of the warrantee. (Swick *vs.* Home Life Ins. Co., 2 Dill. (U. S.) 160; s. c., 4 Big. L. and A. Ins. Rep. 176; Swift *vs.* Massachusetts Mut. Life Ins. Co., 2 N. Y. Supr. Ct., 77 N. Y. 564; Grattan *vs.* Metropolitan Life Ins. Co., 92 N. Y. 274; s. c., 44 Am. Rep. 372.) They mean freedom from any conscious derangement of important organic functions. Goucher *vs.* Northwestern, etc., Assoc., 20 Fed. Rep. 596. *Dyspepsia.*—One may have dyspepsia in its milder forms and still truthfully state that his health is sound. Morrison *vs.* Wisconsin, etc., Ins. Co., 59 Wis. 162. *Cancer.*—The insured represented that his health was good. He showed the medical examiner a pimple on his tongue, but said it was not serious. The examiner made only a cursory examination, and discovered no indications of disease. Prior to this there had been symptoms of cancer, and the insured had consulted two physicians, and shortly afterwards took medical treatment, underwent an operation, and died. *Held*, in an action on the policy, that a nonsuit should be directed. Story *vs.* United L. and A. Ins. Assoc., 4 N. Y. S. Nat. Rep. 373. . . . The company cannot take advantage of fraudulent representations concerning the health of the insured, where it is provided that no question as to the validity of an application or certificate of membership shall be raised after two years, or after the death of the member, and death has occurred. Wright *vs.* Mutual Ben. Life Assoc., 43 Hun (N. Y.), 61.

"Where the health of the party is represented to be good, but before the consummation of the contract there is a material change in this respect, such change should be made known to the company. (Whitley *vs.* Piedmont, etc., Life Ins. Co., 71 N. Car. 480.) Where it is warranted that all material facts concerning the health of the insured have been made known the co

cealment of any will avoid the policy, even though the insured did not know of them himself, even if he had reason to know of them. (The policy was conditioned to be void in case of a concealment of any material fact. At the time the insured was suffering from consumption, but he did not know it, though he had been aware of symptoms sufficient to indicate the nature of the disease, and he stated that he was suffering from general debility. *Held*, that the policy was void. Vose *vs.* Eagle Life, etc., Ins. Co. 6 Cush., Mass. 42. *Vide* also Campbell *vs.* New Eng. Mut. Life Ins. Co., 98 Mass. 381; Britton *vs.* Mut. Ben. Life Ins. Co., 3 N. Y. Supr. Ct. 220: Harris *vs.* Equitable Life Assu. Soc., 6 Thomp., etc., N. Y. 108. But where the insured has no good reason to believe facts material which are not revealed, the policy will not be avoided. Life Assoc. of Scotland *vs.* Foster, 11 Ct. Sess. Cas., 3d Series, 351. *Pregnancy.*—Whether the pregnancy of a married woman is a fact material to be stated by the applicant for insurance on her life is a question to be submitted to the jury. Lefavour *vs.* Insurance Co., 1 Phila., Pa. 558.)

"When the insured is asked if he has had particular affections mentioned, and his answers are made warrantees, he must answer fully and truly. Otherwise the policy will be avoided. It does not matter, in such case, that he does not regard the subject of inquiry as material, or that it is not generally considered as having a certain tendency to shorten life. (The policy provided that it should be void if any statement of insured in his application should be untrue. The insured stated therein that he had not had any spitting of blood, consumptive symptoms, cough, or other affection of the lungs. In fact, about four years prior to the issuance of the policy he had spit blood, and had other symptoms of consumption. He died of this disease three years after the issuance of the policy. In a suit thereon the jury were instructed that it was for them to say whether, at the time of such statement, the insured had had *such* a spitting of blood *and such* affection of the lungs *and* inflammatory cough as would have a tendency to shorten his life. *Held*, that this was error. The *fact* should have been made known to the office. Geach *vs.* Ingall, 14 Mees. and W. 95. *Vide* also to the same effect, Smith *vs.* Ætna Life Ins. Co., 49 N. Y. 211; Horn *vs.* Amicable Mut. Life Ins. Co., 64 Barb., N. Y. 81; Foot *vs.* Ætna Life Ins. Co., 4 Daly, N. Y. 285; Barteau *vs.* Phœnix Mut. Life Ins. Co., 3 N. Y. Supr. Ct. 576; Baker *vs.* Home Life Ins. Co., 4 N. Y. Supr. Ct. 355; s. c., 2 Hun (N. Y.), 402; Bancroft *vs.* Home Ben. Ins. Co., 54 N. Y. Supr. Ct. 332; Archibald *vs.* Mut. Life Ins. Co., 38 Wis. 542; Connecticut Mut. Life Ins. Co. *vs.* Union Trust Co., 112 U. S. 250; Dreier *vs.* Continental Life Ins. Co., 24 Fed. Rep. 670. Nor does it matter that the insured was ignorant of having the disease inquired about. Powers *vs.* N. E., etc., Life Assoc., 50 Vt. 630; Continental Life Ins. Co. *vs.* Young, 113 Ind. 159. Otherwise where his answers are only representations. Mouler *vs.* American Life Ins. Co., 111 U. S. 335. And see Northwestern Mut. Life Ins. Co. *vs.* Gridley, 100 U. S. 614; Schwarzbact *vs.* Ohio Val. Prot. Union, 25 W. Va.

622. But a warrantee that the insured 'has not been afflicted with, nor is subject to, gout, vertigo, fits, etc.,' is not violated by reason of his having had an epileptic fit in consequence of an accident. What such warrantee means is that he was not at the time of the insurance a person habitually or constitutionally afflicted with fits ; a person liable to fits from some peculiarity of temperament, either natural or contracted from some cause or other during life. Chattock *vs.* Shawe, 1 Moody and R. 498 ; s. c., 3 Big. L. and A. Ins. Rep. 10, etc. The policy contained a provision that the insured should have had no chronic disease at the time of the insurance, June 21, 1850. He was examined at the time of the insurance by the company's physician, and appeared to be in perfect health. He was attended in July by a physician for diarrhœa and fever, but he became convalescent. He died October 23, 1850, of chronic inflammation of the intestines and ulceration. *Held*, there was not sufficient evidence that the chronic inflammation of the intestines and ulceration existed at the time his life was insured. Murphy *vs.* Mut. Ben. Life, etc., Ins. Co., 6 La. An. 518. An applicant was asked if he had ever had 'open sores.' He replied that he had not. *Held*, that whether injury received in battle from a bursting shell should have been mentioned was a question for the jury ; that the wound received was not necessarily an 'open sore' within the meaning of that term as used in the application. Home Mut. Life Ins. Co. *vs.* Gillespie, 110 Pa. St. 84.)

"But where the inquiry is more general, the obligation in this respect may be different. If the insured be asked if he has ever had any sickness, or within a limited period mentioned, he is only bound to state important or serious cases of sickness, such as have a tendency to shorten life. The policy provided that the answers to the application were the basis of insurance, and that if they were in any respect untrue, the policy should be void. One of the questions was, 'Has the party had any sickness within the past ten years?' To which the insured replied that he had had pneumonia, but said nothing about a slight attack of chronic pharyngitis some years before. *Held*, that there was no warrantee, and that the slight disease mentioned was an immaterial fact, not bound to be disclosed. (Mut. Ben. Life Ins. Co. *vs.* Wise, 34 Md. 582 ; s. c., 2 Big. L. and A. Ins. Rep. 46 ; 3 Big. L. and A. Ins. Rep. 595, etc.) A fall resulting in serious injury to the head is a fact which should be stated. (Snyder *vs.* Mut. Life Ins. Co., U. S. C. C. E. Dist. Pa., 4 Big. L. and A. Ins. Rep. 424.) He would not be bound, however, to state cases of ordinary headache (Higbee *vs.* Guardian, etc., Ins. Co., 66 Barb. N. Y. 462), but would be bound to state Bright's disease. (Continental Life Ins. Co. *vs.* Young, 113 Ind. 159.)

"Whether the sickness with which the insured was afflicted prior to the insurance was material to be stated should be submitted to the jury. (Morrison *vs.* Muspratt, 4 Bing. 60 ; s. c., 2 Big. L. and A. Ins. Rep. 213 ; Manhattan Life Ins. Co. *vs.* Francisco, 17 Wall. U. S. 672 ; Fitch *vs.* American, etc., Life Ins. Co., 59 N. Y. 557 ; Lefavour *vs.* Ins. Co., 1 Phil., Pa., 558.)

"'Disorder tending to shorten life,' a phrase often used in stipulations

egarding the health of the insured, means a disorder generally having such endency. It cannot be said that a disorder is such a one merely because he party afflicted dies of it. (Watson *vs.* Mainwaring, 4 Taunt. 763.) In this case, Chambre, J., said, 'All disorders have more or less a tendency to shorten life, even the most trifling, as, for instance, corns may end in a mortification; that is not the meaning of the clause. If dyspepsia (which was the disease here in question) were a disorder that tended to shorten life within this exception, the lives of half the members of the profession of the law would be uninsurable.' (*Vide* also Jones *vs.* Provincial Ins. Co., 3 C. B., N. S. 64, etc.; Am. and Eng. Enc. of Law, 13, 632.)"

Expectation of Life.—Tidy[1] says, "Nothing is more uncertain than the duration of a single life, and but few things less uncertain than the average duration of a number of lives. Given there (1) a healthy life, and (2) the absence of any unusual risk, the age of the applicant is practically the only matter for the consideration of the insurance company in granting a policy. Certain well-known tables of the expectation of life at different ages constitute the basis on which the charge to be established is calculated. . . . The expectation of life, by which is implied the number of years that, on an average, a healthy person will live at that age, is capable of reduction to a mathematical formula. Thus, excluding all persons under twenty-five and over seventy-five years of age from our calculations, the formula of Willich, in which x represents the expectation of life, and a the age of the person, nearly represents the facts: $x = 2/3\ (80 - a)$." (See table, p. 586.)

Concealment of Facts (*vide* also Conditions of the Policy, p. 582).—The misrepresentation of the age of the applicant for life insurance will invalidate the policy. (Atty.-Gen. *vs.* Ray, L. R., 9 Ch. 397; Hartford Life, etc., Ins. Co. *vs.* Gray, 91 Ill. 159; Linz *vs.* Massachusetts Ins. Co., 8 Mo. App. 363. But see Continental Life Ins. Co. *vs.* Goodall, Supr. Ct. Cincinnati, 5 Big. L. and A. Ins. Rep. 422; s. c., 3 Am. Law Rec. 338.) The insured is usually inquired of regarding the place of his residence, and an answer to this inquiry is of the same effect as to any other. But the fact that the insured had been nearly two years in another State than the one where he resided was held not to render his answer untrue. (Mobile Life Ins. Co. *vs.* Walker, 58 Ala. 290.) The occupation of the insured must be correctly stated when this information is called for. (Dwight *vs.* Germania Life Ins. Co., 103 N. Y. 341; s. c., 57 Am. Rep. 729.) Thus, where the insured represented that he was a laborer, when he was not, it was held that the policy was avoided. (United Brethren Mut. Aid Soc. *vs.* White, 100 Pa. St. 12.) So if it be provided that the insured shall not engage in a specific business, but he does so, it violates the policy. (The policy provided that the insured should not be connected in any capacity with the ale, wine, or liquor business. He kept a grocery-store with a saloon attachment. *Held*,

[1] Op. cit., vol. ii.

TABLE OF THE EXPECTATION OF LIFE.[1]

Age.	Healthy Lives, Male.	Healthy Lives, Female.	Healthy Lives, Male and Female.	Diseased Lives, Male and Female.	Age.	Healthy Lives, Male.	Healthy Lives, Female.	Healthy Lives, Male and Female.	Diseased Lives, Male and Female.
	Years of Life.	Years of Life.	Years of Life.	Years of Life.		Years of Life.	Years of Life.	Years of Life.	Years of Life.
0	58.43	55.53	57.64	55.56	50	20.30	21.60	20.51	18.29
1	57.43	54.53	56.64	54.56	51	19.63	20.94	19.84	17.73
2	56.43	53.53	55.64	53.56	52	18.97	20.18	19.17	17.13
3	56.31	52.53	55.09	52.56	53	18.29	19.60	18.50	16.52
4	55.31	53.04	54.83	51.56	54	17.60	18.86	17.81	15.93
5	54.31	52.04	53.83	50.56	55	16.93	18.17	17.14	15.45
6	53.76	51.04	53.08	49.56	56	16.32	17.53	16.53	14.84
7	53.13	50.90	52.67	48.56	57	15.69	16.88	15.90	14.20
8	52.13	49.90	51.67	47.56	58	15.07	16.16	15.26	13.74
9	51.13	49.18	50.80	46.56	59	14.44	15.56	15.64	13.23
10	50.29	48.18	49.89	45.56	60	13.80	14.85	13.99	12.62
11	49.69	47.78	49.38	44.56	61	13.23	14.21	13.42	12.19
12	48.69	46.78	48.38	43.56	62	12.66	13.50	12.83	11.60
13	47.88	45.78	47.50	42.56	63	12.09	12.92	12.26	11.09
14	47.05	44.78	46.60	41.56	64	11.54	12.38	11.72	10.64
15	46.24	44.27	45.90	40.56	65	11.01	11.78	11.17	10.26
16	45.34	43.82	45.14	39.56	66	10.49	11.24	10.65	9.85
17	44.34	43.11	44.23	39.09	67	9.98	10.63	10.12	9.38
18	43.53	42.20	43.39	38.09	68	9.46	10.10	9.61	8.99
19	42.79	41.42	42.64	37.09	69	8.99	9.60	9.13	8.56
20	42.09	40.87	41.98	36.80	70	8.54	9.12	8.68	8.16
21	41.33	40.17	41.23	36.16	71	8.02	8.61	8.16	7.67
22	40.62	39.40	40.51	35.73	72	7.52	8.09	7.65	7.18
23	39.87	38.61	39.84	35.15	73	7.12	7.58	7.24	6.77
24	39.18	37.95	39.15	34.84	74	6.69	7.27	6.83	6.32
25	38.44	37.40	38.44	34.01	75	6.42	6.99	6.56	6.10
26	37.64	36.80	37.65	33.47	76	6.03	6.57	6.17	5.90
27	36.90	36.21	36.93	32.87	77	5.69	6.29	5.85	5.69
28	36.14	35.69	36.18	32.36	78	5.33	5.92	5.48	5.38
29	35.42	35.07	35.47	31.64	79	5.00	5.86	5.22	5.21
30	34.68	34.55	34.75	31.03	80	4.71	5.56	4.93	4.98
31	33.96	33.90	34.04	30.46	81	4.40	5.17	4.61	4.60
32	33.21	33.27	33.30	29.81	82	4.14	4.90	4.36	4.52
33	32.48	32.75	32.59	29.13	83	3.90	4.35	4.04	4.17
34	31.75	32.04	31.86	28.43	84	3.79	3.92	3.84	3.52
35	31.03	31.43	31.15	27.76	85	3.51	3.71	3.58	3.01
36	30.28	30.80	30.41	27.11	86	3.34	3.62	3.44	2.87
37	29.55	30.21	29.69	26.51	87	3.13	3.51	3.26	2.69
38	28.83	29.55	28.97	25.75	88	2.87	3.40	3.05	2.99
39	28.12	28.88	28.27	25.13	89	2.81	3.14	2.94	2.78
40	27.42	28.24	27.57	24.49	90	2.35	3.33	2.68	4.05
41	26.69	27.59	26.85	23.82	91	1.91	3.88	2.46	3.05
42	25.96	26.97	26.14	23.15	92	1.55	3.72	2.25	2.90
43	25.24	26.30	25.42	22.51	93	1.40	3.71	2.34	3.50
44	24.50	25.68	24.69	21.80	94	2.21	3.25	2.90	2.50
45	23.79	24.96	23.98	21.11	95	1.21	2.25	1.90	1.50
46	23.08	24.26	23.27	20.95	96	.50	1.25	1.06	.50
47	22.37	23.68	22.57	20.26	97	. .	1.00	1.00	. .
48	21.68	23.02	21.89	19.57	98	. .	.50	.50	. .
49	20.98	22.34	21.20	18.92					

[1] From Tidy's Legal Medicine, vol. ii. p. 2.

that the continuance of this business after the issuance and deliverance of the policy violated it. McGurk *vs.* Metropolitan Life Ins. Co., Conn., 16 Atl. Rep. 263.) It is also provided that if the insured shall change his occupation without the consent of the company the policy shall be void. This means engaging in another employment as a usual business. (Stone *vs.* United States Casualty Co., 34 N. J. L. 371.) But where it is not pro-ided that a change of occupation shall avoid the policy, such a change will ave no effect upon the contract. (Provident Life Ins. Co. *vs.* Fennell, 49 l. 180.) For the stipulation to have effect, the change must have actually id fully occurred. If death happens while making the change, but before consummation, though by reason thereof, recovery may be had. (Sum-ers *vs.* United States Ins., etc., Co., 13 La. An. 504.) A warrantee that : insured is single, when he is married, avoids the policy. (Jeffries *vs.* onomical Life Ins. Co., 22 Wall., U. S. 47 ; Jeffries *vs.* Union Mut. Life s. Co., 1 McCrary, U. S. 114 ; United Brethren Mut. Aid Soc. *vs.* White, o Pa. St. 12.)

"Where a husband, as the agent of his reputed wife, takes out a policy his life for her benefit, representing that she is actually his wife, when she not so, by reason of her having a husband living at the time of their mar-ge, it has been held that the policy is not void, unless they knew at the ie of taking out the policy that the lawful husband was living at the time the second marriage." (Equitable Life, etc., Soc. *vs.* Patterson, 41 Ga. 8, etc. ; Am. and Eng. Enc. of Law, 13, 635.)

If a true representation as to the use of intoxicating liquor, opium, etc. pium and chloral habits), was made at the time the application for in-rance was filed, and the insured subsequently becomes addicted to the temperate use of liquor, etc., this would be no bar to a recovery of the licy. But if a concealment was made of the fact that the applicant was temperate at the time of his receiving a policy for life insurance, recovery on the latter would be questionable. (*Vide* also works on Law.)

The right to recover on the policy would be forfeited if the insured, who usually compelled to furnish in his application the name and address of s medical adviser, should state that he had had no medical attendance or escription.

Intemperance in Relation to Life Insurance.—The question whether e habitual use of liquor or various drugs has a tendency to shorten the istence of man is one that might be raised in life insurance cases. To rnish a correct definition of what is implied by the word *intemperance* is an tremely difficult matter. Chapman[1] says, "It is astonishing what a dif-ence of opinion prevails among even intelligent people as to what consti-tes a temperate person, many an individual who takes several drinks of andy or whiskey a day considering himself perfectly temperate, and so iting to the medical examiner, utterly unconscious of his health being

[1] Op. cit., p. 148.

DOBELL'S DECLARATION OF THE PERSON TO BE ASSURED.

QUESTIONS to be REPLIED to by the ASSURER whose name is hereunto affixed B EXAMINATION. The Directors wish to impress upon the Assurer the neces giving *full* and *correct* answers to the following questions :

1.—Age *next* birthday?..........
Married or single?..........

2.—What is your occupation? Is it active or sedentary? How do you bear unusual fatigue?..........

3.—If now and generally in good health?..........
(*a*) State your height,..........feet..........inches. Weight,.......... stones..........lbs. (*b*) Are you increasing or decreasing in weight?..........

4.—Are your habits of life sober and temperate?..........
Have they *always* been so?..........

5.—Have you had the small-pox or been vaccinated?..........
(State which.)..........

6.—Have you ever been bled or cupped, or undergone any surgical operation? If in the affirmative, state particulars..........

7.—Have you ever suffered from

Varicose veins?..........
Rupture? If so, is a truss constantly worn?..........
Delirium tremens, apoplexy, fits of any kind, paralysis?..........
Any head affection?..........
Spitting or other discharges of blood? (describe fully)..........
Cough? If so, its character and duration..........
Any affection of the chest or throat?..........
Cancer, scrofula, jaundice, or dropsy?..........
Gout, when, and in what part?..........
Rheumatic fever, when, and its duration, and was your heart affected by it?..........
Any affection of the stomach or bowels?..........
Piles or fistula, which?..........
Any affection of the kidneys or bladder? (state particulars)..........
Have you had any illness not already stated?..........

N.B.—Much trouble and after-correspondence will be spared by distinct information as to the causes of death.

When there is any doubt about the cause of death (or when it is said to have been connected with childbirth), state *definitely* whether the person was or was not consumptive.

8.—Family History.

Father alive, aged.................................. *Health*,..................................

Mother alive, aged.................................. *Health*,..................................

Father died, aged.................................. *Cause of death*,..................................

Mother died, aged.................................. *Cause of death*,..................................

.... *Brothers alive, ages and health*,..................................

.... *Sisters alive, ages and health*,..................................

.... *Brothers died, ages and causes of death*,..................................

.... *Sisters died, ages and causes of death*,..................................

9.—Has any member of your family, not mentioned above, suffered from consumption or insanity? If so, give particulars. (This refers especially to uncles, aunts, and first cousins.)..................

10.—Have you ever resided abroad, where, and for what period?..........
If so, was your health affected thereby?..................................

11.—Do you know, have you been informed, or do you suspect that disease or disorder of any kind exists in your constitution?......

12.—Are you aware of any circumstances not already stated, connected with your family, or your own constitution, health, or habits, tending to render an Assurance on your life more than usually hazardous?..................................

13.—*If a Woman,*—

(*a*) What is the condition of the uterine functions at present?......

(*b*) If married, how long?..................................

(*c*) Have you ever had any children or miscarriages, and have your confinements proved favorable or not?..................

(*d*) State whether pregnant or not..................................

I hereby declare that the answers to the above questions are to the best of my knowledge and belief in all respects true.

As witness my hand this.................. *day of*.................................. *18*

Signature of the Assurer,..................................

Signed in the presence of the Medical Examiner,
whose name is hereunto affixed. ....

DOBELL'S REPORT BY THE MEDICAL EXAMINER, WHOSE NAME IS HEREUNTO AFFIXED.

On the Life of...*of*..........................

Questions	Remarks
1.—Was the declaration already given signed in your presence?.......... Is the Assurer known to you? and what opportunities have you had of becoming acquainted with his health, habits, and constitution?.......... Describe the present appearance.......... Is the aspect healthy?..........	
2.—What is the *actual* rate of pulse (standing)?.......... Is the pulse normal in rhythm, volume and force, etc.?.......... (*If the answer is in the negative, give particulars.*).......... Are the pulsations and sounds of the heart quite normal?.......... If not, state defects..........	*If the applicant has ever suffered from Rheumatism or Rheumatic Fever, please to direct especial attention to the heart.*
3.—Are the proportions and development of the chest normal?.......... Is the general character of respiration normal?.......... Do the subclavian regions expand normally in respiration?.......... Is the respiratory murmur above and below the clavicles normal?.......... What do you consider to be the condition of the lungs?.......... (*If there is anything abnormal, give particulars.*)..........	*Attention is particularly requested to these questions, as Phthisis is one of the principal causes* from which Insurance Offices suffer loss.
4.—What is the condition of the tongue?..........	
5.—Have you any reason to suspect disease of the urinary or generative organs?.......... (*If you suspect disease of the kidneys, say, is the urine coagulated by heat and*	

... and is there any reason to apprehend (*e*) an apoplectic seizure?..........

7.—If there is rupture, what is its nature and duration?..........
Is it constantly and efficiently supported by a truss?..........

8.—Have you reason from any source whatever to suspect the proposer *is now* or *has been* of irregular or *intemperate* habits, or *addicted to any habits or pursuits likely to shorten life?*..........

Attention is particularly requested to this point.

9.—Is any circumstance known or suspected by you not already stated that might render the life more than usually hazardous?..........

CONFIDENTIAL OPINION.

I hereby certify that the answers given by me above are according to the best of my knowledge and belief, and, after a careful consideration of the personal condition and of the personal and family history, I am of opinion that the life should be placed in the

1st Class.—*Average Lives.* Such as have either no unfavorable circumstances of health or family history, or in which the unfavorable circumstances are so slight as to form no impediment to Assurance at the usual rate..........

2d Class.—Lives such as require an *addition* to the premium to cover increased risk. State how many years should be added to the present age of Assurer to cover the risk..........

3d Class.—Lives such as should be declined..........

Signed,..........

gradually undermined and of his life being shortened by the daily use of alcohol. It is due to such a difference of opinion as to the effect of alcohol upon the system that the question of intemperance has given rise to so much discussion in cases of life insurance. While it is undoubtedly true that there have been exceptional cases of individuals enjoying good health and living to a good old age who had been in the habit of drinking, and more particularly whiskey, all their lives, nevertheless it cannot be denied that, as a general rule, the habitual use of alcohol in perverting nutrition induces disease of the heart, liver, and kidneys, and so tends to shorten life."

Relation of Suicide to Life Insurance.—Suicide committed for the express purpose of liquidating debts or leaving money to the heirs would invalidate the insured's policy. But if the insured person committed the act after the policy was taken out, while laboring under insanity, the heirs would undoubtedly be entitled to the payment of the insurance money.

The Medical Examination.—In conducting a medical examination for life insurance, the first essential is the identity of the applicant, for cases are recorded where the attempt has been made to substitute a person perfect in health for the real applicant, who, perhaps, would not be able to pass the medical inspection satisfactorily.

Strict inquiry should then be made concerning the applicant's mode of life, habits, etc. Before beginning the physical examination much may be gleaned respecting him by noting his general appearance, expression, manner, gait, etc. Note particularly whether the eye is bright or dull, the complexion healthy or dull, or whether it reflects the signs of dissipation or disease, etc. If the skin be hot, the temperature thereof should be observed; but it is well to remember that many persons become unduly nervous when undergoing a medical inspection.

Many examiners, as a preliminary to the regular examination, question the applicant as to his occupation, residence, etc. It is also a very good plan to inquire respecting the sanitary conditions of the place wherein he resides. Learn particularly whether he is addicted to alcoholics, or whether he shows signs of opium or chloral habits. Ascertain his family history, hereditary or acquired predispositions, and mental and moral status.

The examination should always be conducted in private for obvious reasons, and usually in the examiner's office, although for the sake of convenience it may sometimes take place at the applicant's residence. It is not necessary here to particularize the various affections of which an applicant might show evidence, as it is presumed that every practitioner of medicine is already familiar with the more common diseases ; hence all that will be stated is the plan of examination. The following systems should be investigated in turn : (1) the nervous system (under this heading is also included the muscular system), (2) the respiratory system, (3) the circulatory system, (4) the digestive system, and (5) the genito-urinary system. The issuance of a life insurance policy should not occur unless the urine of the applicant has been carefully tested and found to be in a healthy condition. It is well to

ecollect this point, as some persons, who otherwise are first-class risks, ossess highly albuminous urine, which, if persistent, should cause the re-ection of the applicant. The same holds true respecting other abnormal leposits. Tidy[1] says, "As regards the generative organs, sexual incapacity n males is an early symptom of diabetes and of many neuroses. It must be remembered, too, as regards females, that the uterus and ovaries are favorite seats of cancer and of cystic disease respectively. In the male stricture of the urethra should be regarded as an element of danger."

Having completed his examination, the physician is required to fill up the blanks, which may be obtained at the home office of the company, so as to make the necessary reports. Some such form as that on pages 590 and 591 may be used.

"In view of the essential qualifications of a medical examiner, his respon-sibilities, the necessity of thorough investigation, the demands made on his time by insurance companies, and the delicate attitude he sustains both toward the company and the applicant, his fee in no case should be less than five dollars,—in some instances more,—and should always be paid by the company and from the home office." (McSwain.)

CHAPTER XLII.

PHARMACEUTICAL JURISPRUDENCE.[2]

BY JUDGE GEORGE F. ROESCH,

Member of the New York Bar.

Definition—Foundation of the Office—History of the Laws—Constitutionality of Laws regulating the Practice of Pharmacy—The Revocation of a License—Liability of the Pharmacist—Registration—Civil Liability of Pharmacists—Prescriptions, etc.

Pharmaceutical jurisprudence may be defined as that body of ritten and unwritten laws which affect the transactions of patients and the eneral public in their dealings with those skilled in the art and practice of reparing and preserving drugs, and of compounding and dispensing medi-ines. No doubt the codes of civilized countries have at all times contained rovisions for the regulation of the practice of pharmacy. Shakespeare, the "myriad-minded man," as Coleridge terms him, makes us acquainted in "Romeo and Juliet" with the laws of Mantua. He gives us, too, a vivid icture of an ancient druggist and his shop. Romeo has just been informed

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[1] Op. cit.

[2] Being a synopsis of a lecture delivered October 9, 1895, before the Alumni Asso-ciation of the New York College of Pharmacy.

of the death of Juliet. He seeks in self-destruction reunion with his lost beloved.

> "I do remember an apothecary,—
> And hereabouts he dwells,—whom late I noted
> In tattered weeds, with overwhelming brows,
> Culling of simples; meagre were his looks,
> Sharp misery had worn him to the bones;
> And in his needy shop a tortoise hung,
> An alligator stuffed, and other skins
> Of ill-shaped fishes; and about his shelves
> A beggarly account of empty boxes,
> Green, earthen pots, bladders, and musty seeds,
> Remnants of packthread, and old cakes of roses,
> Were thinly scattered to make up a show."

Romeo calls on the apothecary and asks him for "a dram of poison." The latter answers, "Such mortal drugs I have: but Mantua's law is death to any he that utters them."

But he gives him the poison, saying, "My poverty, but not my will, consents."

The wily apothecary wished to avoid the charge of a criminal intent in breaking the law.

The real foundation of the office of apothecary in England was laid in 1543, in an act of Parliament, 34 and 35 Henry VIII., ch. 8. Its preamble speaks severely of the ignorance and cupidity of London surgeons, and then, as a remedy, provides for the toleration and protection of irregular practitioners, who afterwards, as a body, became known as apothecaries.

It is interesting, in view of modern prosecutions of druggists for selling remedies without a physician's prescription, to notice that this act distinctly ordains "that it shall be lawful to every person, being the king's subject, having knowledge and experience of the nature of herbs, roots, and waters, or of the operation of the same by speculation or practice, to practise, use, and minister in and to any outward sore, wound, swelling, etc., according to their cunning, experience, and knowledge, and without suit, trouble, or penalty." So that the skill of the apothecary could, without hinderance, be called into service in a *quasi*-medical capacity by the people of those days.

. . . The practice of pharmacy is now regulated in this State by art. xi. of ch. 661 of the laws of 1893, being an act in relation to the public health, and forming ch. 25 of the "public health law." It provides for a State Board of Pharmacy, excepting the counties of New York, Kings, and Erie, of five members, each to hold office for five years from the first Tuesday of September of the year in which such term begins.

The New York State Pharmaceutical Association at each annual meeting nominates five resident pharmacists of the State, outside of said counties, from which number the governor fills each vacancy happening after each nomination. The members of the board take the usual oath, and meet annually

on the first Tuesday of September, at noon, and elect a president, secretary, and treasurer for one year. Other meetings are held at least once in three months. The board makes by-laws and regulations for the examination of applicants for license. There are two grades of licenses granted,—that of pharmacist, which confers the privilege of carrying on the practice of pharmacy, either on his own account as proprietor or for some other person, and that of assistant pharmacist, which permits the holder to retail medicines and poisons, but not to compound physicians' prescriptions in the absence of the licensed pharmacist.

The board must examine applicants and grant licenses, keep a record of pharmacists and assistants, investigate complaints of violations of the law, bring such cases and all infractions of the penal code to the notice of the proper prosecuting officer, and render annually to the governor and the State Pharmaceutical Association a full statement of its receipts and disbursements. Any person who has had four years' experience in the practice of pharmacy, previous to January 1, 1893, or holds a certificate of registration as a pharmacist by examination from any board of pharmacy legally created under the laws of this State, is entitled to become a pharmacist. Any person who has had two years' experience in the practice of pharmacy is entitled to license as an assistant pharmacist, each upon passing the requisite examination. Any person who on May 24, 1884, was entitled to a license, but failed within ninety days to apply to the State Board for a license, might, within ninety days after the passage of that act, on eight days' notice to the secretary of the board, have applied to the Supreme Court for an order directing the board to issue such license, upon proof of good cause for such neglect. No person is entitled to license as a pharmacist or assistant unless he furnishes proof, by his own affidavit or otherwise, in addition to all the other requirements of the law, that he is a resident of the city, county, or district for which the board to which he applies is created, or, if a non-resident, that he intends to practise therein, and that he has not applied for a license to or been examined by any other board of pharmacy of the State, and has not been refused a license within six months preceding. By that statute a fee of five dollars was to be paid to the State Board for a pharmacist's license, and three dollars for that of an assistant pharmacist. The license must be conspicuously posted in the licensee's place of business. No license shall be revoked except for just and sufficient cause, and no one may hereafter practise as a pharmacist unless a license has been granted by the State Board. The statute does not apply to practitioners of medicine who are not the proprietors of stores, and does not prevent them from supplying patients. Nor does it apply to wholesale dealers in medicines or poisons, nor to the sale of insect poisons or substances for use in the arts, or to the manufacture or sale of proprietary medicines, or to the sale of the usual domestic remedies by retail dealers in rural districts. These remedies are defined in the act as those, a knowledge of the properties of which and dose has been acquired from common use, and includes only such remedies as may be safely em-

ployed without the advice of a physician. A large number of them are named in the act; but the term does not include poisons requiring knowledge and pharmaceutical skill to safely dispense, unless they are sold in original packages, or such as bear the label of a licensed pharmacist. This act itself also furnishes us with a definition of the term "practice of pharmacy" as meaning the compounding of prescriptions, or of any U. S. Pharmacopœal preparation, or of any drug or poison, to be used as a medicine, or to the retailing of any drug or poison, except as in the act provided for. The law does not prohibit the employment of apprentices for the purpose of being instructed in the practice of pharmacy, but they are not permitted to dispense prescriptions, or sell or furnish medicines or poisons, except in the presence and under the supervision of a licensed pharmacist. The article does not apply to the counties of New York, Kings, and Erie, but a license duly issued by any legal board of pharmacy entitles the holder to a license or certificate of registration from any other board upon complying with the formal requirements of the law. Any person violating any provision of the article forfeits fifty dollars for every such violation to the county, to be sued for and recovered in the name of the county by the State Board. It retains the cost and expenses out of all penalties, and one-half of the penalty goes to the county treasury. The expenses of the State Board are defrayed out of the fees and the moiety of such penalties.

In the matter of Ward, 10 Misc. Rep. 424, Judge Herrick, at Albany, held that the act of 1893 was evidently intended to take the place of all statutes thereto passed. Charles W. Ward had failed to apply within the ninety days provided for in the act of 1893, and sought to compel the State Board to license him, notwithstanding that fact. Judge Herrick denied his motion, and held that no period is prescribed within which a person must apply for a license who has had four years' experience in the practice of pharmacy previous to January 1, 1893. But as to those qualified under the act of 1884, who failed to make application within ninety days after the passage of the act of 1893, there is no provision in the statute for obtaining a license except by passing an examination. But we must take into consideration the amendments passed by the Legislature of 1895. By the act which went into effect on June 4, 1895, any person who has had four years' experience in the practice of pharmacy, or holds a certificate of registration as a pharmacist, is entitled to a license as such, and two years of experience will entitle him to be an assistant pharmacist, if otherwise qualified. The fees are made ten dollars for a license as a pharmacist from the State Board, five dollars for a license or certificate of registration after examination by other boards, and three dollars for a license as an assistant. The license from the State Board seems indispensable. I also understand that the last Legislature passed an act, introduced by Senator Donaldson, requiring every licensee of the State Board of Pharmacy who desires to continue the practice of his profession to pay annually within thirty days from November 1 a fee of one dollar, for which he shall receive a renewal, to be displayed with the license.

The regulations of the local boards are readily ascertained, and they strive with the State Board to maintain a high degree of excellence as to the requisites of admission to practise in pharmacy. Those applicable to this city are found in the Consolidation Act.

The constitutionality of laws regulating the practice of pharmacy has been affirmed by the Supreme Court of the United States. Judge Field, in Dent *vs.* West Virginia, 129 U. S. 114, declared that "due consideration for the protection of society may well induce the State to exclude from practice those who have not such a license, or who are found upon examination not to be duly qualified." (See also State *vs.* Donaldson, 41 Minn. 74; State *vs.* Farian, 65 N. H.; People *vs.* Moorman, 86 Mich. 433; State Board *vs.* White, 84 Kent, 606.)

Of course these laws, like many others which infringe upon personal liberty, may frequently in individual cases, because of their peculiar surroundings, work seeming injustice; but in the exercise of the police power of the State, in protection of the public health, their enactment has repeatedly been upheld by the courts. In England, in the beginning of the eighteenth century, the College of Physicians prosecuted Apothecary Rose successfully in the Court of King's Bench, for prescribing a bolus for Seale, the butcher. (3 Salk. 16; 6 Mod. 44.) But Apothecary Rose, insistent upon his rights, as apothecaries usually are, won on appeal to the House of Lords (5 Bro. Parl. Cases, 553), because the peers did not believe that every one should be compelled, when sick, to call in "a physician to prescribe, an apothecary to dispense, and a surgeon to let blood." But even their quackery drove the apothecaries to procure the passage of the act of 53 George III., ch. 194, forbidding any one to practise without a license, and their courts, too, have ever since enforced laws similar to our own. The English apothecaries' act of 1815, just mentioned, is the parent of most of the American legislation upon the subject, though our laws exceed that statute in severity in the provisions of our criminal codes.

So, too, these laws in our country have been sustained in so far as they forbid others than graduates of certain schools to practise, requiring a certain period of residence in the State, permitting all actually in practice at the time of the passage of a law to continue to practise upon registration, but imposing certain burdens upon others; forbidding licensed physicians from conducting drug-stores, except in compliance with the pharmacy law, and creating State boards of examiners. (Hewitt *vs.* Charles, 16 Pick. 353; State *vs.* Vanderslins, 42 Minn. 129; 43 N. W. 789; State *vs.* Green, 112 Ind. 462; 14 N. E. 352; State *vs.* Hathaway, 21 S. W. 1081; State *vs.* Creditor, 24 Pac. 346; Brown *vs.* People, 11 Col. 109; 17 Pac. 104.)

Again, a license may be revoked for unprofessional conduct, or such other causes as the statute or the board may prescribe. But the holder must have notice and an opportunity to answer the charges against him. (Gage *vs.* Censors, 63 N. H. 92–94; State *vs.* Med. Ex. Bd., 32 Minn. 324; People *vs.* McCoy, 125 Ill. 289; 30 Ill. App. 272; State *vs.* Schultze, 28

Pac. 643.) So, on the other hand, a mandamus would lie to compel a board to grant a license, if they arbitrarily and without just cause refuse it. (Harding *vs.* People, 10 Colo. 387; Dental Exrs. *vs.* People, 123 Ill. 227; People *vs.* Bellevue, 60 Hun, 109; State *vs.* Fleischner, 41 Minn. 69.) An unlicensed practitioner would not be entitled to exemption from jury duty. It is questionable whether he could maintain an action for slander, if a jealous competitor would call him a quack. (Hargan *vs.* Purdy, 20 S. W. 432; Skirving *vs.* Ross, 31 Upper Can. C. P. 423; Collins *vs.* Carnegie, 1 A. and E. 695.)

An unlicensed practitioner could not recover for prescriptions compounded by him and not paid for by his customers. Such cases would fall within the principle of Ferdon *vs.* Cunningham, 20 How. P. 154; Lauger *vs.* Unterbury, Misc. 210; and Bloom *vs.* Soberski, 8 Misc. 311, that where a statute prescribes certain regulations, compliance with them is prerequisite to recovery. There are things which one may not do, although he have a license. If one prescribes under the guise of selling patent medicines or drugs, it would constitute medical, not pharmaceutical, practice. (Alcott *vs.* Barber, 1 Wend. 426; Thompson *vs.* Staats, 15 Wend. 395; Smith *vs.* Tracey, 2 Hall, 465; Underwood *vs.* Scott, 43 Kan. 714; 23 Pac. 942; State *vs.* Doran, 109 N. C. 864.) On the other hand, a man was accustomed to gather herbs, was called doctor in his neighborhood, gave remedies to a sick friend, and advised him as a neighborly act, without a fee. He was not held to practise, and was acquitted. (Nelso *vs.* State Ala., 12 So. 421.)

The liability of a pharmacist is of a dual nature,—criminal and civil. A criminal proceeding may be prosecuted against him, and a civil action for damages brought at the same time. Nor can he by a settlement of the latter expect to compound the former, for that might in itself amount to a felony. The original liability is that defined in the Penal Code and in the Consolidation Act of the city of New York. It is well to bear in mind that section 29 of the Penal Code makes every one a principal in the commission of a crime, whether he directly commits the act, aids or abets in its commission, is present or absent, or directly or indirectly counsels or procures another to commit it.

Section 191 prescribes that a person who provides, supplies, or administers any medicine, drug, or substance, or uses or employs, or causes to be used or employed, any instrument or other means for improper purposes, unless to preserve the life of woman or child, is guilty of manslaughter in the first degree, punishable by a term of imprisonment not exceeding twenty years.

Section 200 provides that a physician or surgeon who, in a state of intoxication and without a design to effect death, administers a poisonous drug or medicine, is guilty of manslaughter in the second degree, punishable by imprisonment for a term not exceeding fifteen years, or a fine of not more than one thousand dollars, or both. There is no such provision with ref-

erence to pharmacists. There would, then, seem to be tacit legislative recognition of pharmaceutical sobriety.

Section 217, subdivision 2, ordains that administering any poison or other destructive or noxious thing, so as to endanger life, or causing it to be taken by another, is assault in the first degree.

Section 218 provides that administering a drug or medicine, the use of which is dangerous to life or health, with intent to injure, or with intent to assist in or make possible the commission of any crime, when not amounting to assault in the first, is assault in the second degree.

Section 297 makes the manufacture, sale, or giving away of an instrument, medicine, or drug for unlawful purposes a felony.

Sections 318, 319, and 320 make it a misdemeanor to sell, lend, give away, exhibit, or mail any instrument, article, recipe, drug, or medicine for unlawful purposes, and allows the issuance of a search-warrant in aid of the law.

Sections 364 to 368, inclusive, provide severe punishment for counterfeiting trade-marks, and apply equally to the sale, keeping, or offering for sale of goods represented as the product or manufacture of a person not the manufacturer. In this connection I call attention to the discovery by the Carter Medicine Company, a few weeks ago, of a counterfeit of its trademark, "Carter's Little Liver Pills." Several arrests were made, and, upon conviction, Justice Jerome, in passing sentence of three months in the penitentiary, said, "The whole value of many of these articles lies in the trademarks. Thousands and hundreds of thousands of dollars are spent annually in placing them before the public. If the public cannot rely upon these articles, then a fraud is being practised upon them, and upon the proprietary rights of those persons who own trade-marks. This is a class of cases upon which this court does not look with any leniency whatever."

The court did not intend any sarcasm, but the whole value of many of these articles does lie in the trade-mark, not in the compound itself.

Sections 401 and 405 relate to the omission of apothecaries to label drugs, or labelling them wrongly, and compel a druggist to keep a poison-book, in which must be recorded the name and residence of the person receiving the poison, together with its kind and quality, and the name and residence of a witness, unless sold upon the written order or prescription of a physician, whose name must be attached to it. The poison-book must be submitted to the inspection of any person upon reasonable demand during ordinary business hours, and the refusal to do so is punishable by a fine not exceeding fifty dollars. A poison must be labelled, unless sold upon such order, with the name "poison," and have its name written or printed upon it.

No one employed in a drug-store is allowed to prepare a medical prescription unless he served an apprenticeship of two years, or is a graduate of a medical college, or college of pharmacy, except under the direct supervision of some person duly qualified; nor is it permissible to prepare a medical prescription, except under such supervision. The penalty is a fine not exceeding one hundred dollars, or imprisonment not exceeding six

months. If death results, the person offending is guilty of a felony, punishable by a fine of not less than one thousand dollars or more than five thousand dollars, or of imprisonment of not less than two years or more than four years, or both fine and imprisonment.

Sections 407 and 408 punish the adulteration of drugs and medicines, or selling, offering or exposing for sale, if for any cause unfit to be used, as a misdemeanor.

Sections 438 and 438*a* punish the use of false labels upon any article as a misdemeanor.

Sections 580 to 584, inclusive, make the use or possession of false weights and measures or other apparatus a misdemeanor.

The Consolidation Act of the city of New York, section 2915, makes it unlawful for any but a graduate or licentiate in pharmacy to open or conduct any pharmacy or store for retailing, dispensing, or compounding medicines or poisons in the city of New York, except as provided in the act; but by the amendment of the laws of 1889, ch. 448, the widow or legal representative of a deceased graduate or licentiate may continue his business, if the actual retailing, dispensing, or compounding of medicines or poisons be only by a graduate or licentiate in pharmacy.

The Penal Code, sections 404, 725, and 726, did not repeal this section, and section 405 merely relates to persons employed in a drug-store, and not to the proprietors. (People *vs.* Routey, 21 N. Y. Rep. 173; s. c., 4 N. Y. Suppl. 235; 51 Hun, 643.)

Under section 2016 no one can be registered but a graduate or licentiate, or a graduate having a diploma from some legally constituted medical college or society.

We are furnished with the definition of graduates and licentiates in section 2017, which provides that graduates are those having at least four years' experience in stores where medical prescriptions have been compounded, and having obtained a diploma from any college of pharmacy in the country, or from some authorized institution or examining board. Licentiates are those who have had a like experience, and passed an examination either before the board established on March 28, 1871, or before that created by ch. 817 of the laws of 1872. Foreign pharmacists who present satisfactory credentials or certificates of their competency and qualifications to said board may also be allowed to practise as such. Junior assistants or apprentices are not permitted to prepare physicians' prescriptions.

In section 2018 the College of Pharmacy is called upon to elect on the first Monday in April of every third year, at a special meeting, five competent pharmacists, of whom three shall be graduates of a medical college and two of a college of pharmacy in this city, to constitute the Board of Pharmacy. Within thirty days after their election they take the oath, and then hold office for three years, and until their successors are duly elected and have qualified. If there be a vacancy, the trustees of the college fill it from two or more nominees elected at a special meeting of the college. The board

lects a president and secretary, and must meet at least once every three onths, and three members constitute a quorum. The board must transact ll business pertaining to the legal regulation of the practice of pharmacy in is city, examine and register pharmacists, and, after satisfactory examinaon, furnish certificates of competency upon payment of a fee of five dollars.

In section 2019 it is made the duty of the secretary to keep a book of gistration of the names and places of business of persons affected by the r. All must register and pay a fee not to exceed two dollars for pharmats and one dollar for assistants. The moneys received defray the expenses the board, and any surplus is for the benefit of the college. The salary the secretary is fixed by the board and paid out of the registration fees. ery registered pharmacist is to be held responsible under section 2020 for quality of all drugs, chemicals, and medicines he may sell or dispense, cept those sold in the original packages, and patent medicines; and should knowingly, intentionally, and fraudulently adulterate or cause to be adulated such drugs, chemicals, or medical preparations, he is guilty of a mismeanor, and liable to a penalty not exceeding one hundred dollars, and in dition his name is stricken from the register.

No person is allowed, according to section 2021, to retail any poisons umerated in the two schedules annexed to it, and which are well known in ug-stores.

In section 2022 it is declared that nothing contained in the foregoing ction applies to medical practitioners who do not keep open shop for reiling medicines and poisons, nor to the business of wholesale dealers; but e preceding section and its penalties do apply to them.

Under section 2023 any one who attempts to procure false registration r himself or another is liable to a penalty not exceeding five hundred ollars. A registered pharmacist who permits a person not registered to mpound and dispense prescriptions, or any person not registered who eps open shop for such purpose, or fraudulently represents himself to be gistered, or any registered pharmacist or dealer in medicines who fails to mply with the law in relation to poisons, is deemed guilty of a misdeanor, and liable to a penalty of fifty dollars.

Pursuant to section 2024, the penalties recovered are paid to the trustees the College of Pharmacy, and expended for the benefit of its library. I l not, however, find any provisions in these sections for procuring their forcement. This is to be deplored, not alone for the sake of the college d its library, but of the profession itself. It might be well if the recent olesome investigations into the adulteration of milk were extended to ıgs and medicines. It would, furthermore, be extremely advantageous if ne such officer of the city government as the corporation attorney were quired to institute and conduct prosecutions under these sections.

As to the civil liability of pharmacists, the sparseness of litigation conrning it is a powerful testimonial to the painstaking care and professional

skill of the druggist of to-day. Almost every vocation in life furnishes far more occasion to the courts for the definition of personal rights and obligations arising out of allegations of negligence than does that of the pharmacist. The law-books are full of cases touching the alleged incompetency of men of other professions, while the instances in which an apothecary appears as a defendant on account of unskilfulness are comparatively rare. It is true that in more recent years some grave questions have arisen and caused some volume of litigation. But these, in the main, relate, as it were, to the purely mercantile side of the calling as regards proprietary medicines and the like, and not to any difficulties arising out of the compounding of prescriptions. The question has been submitted as to who owns the prescription. Our courts have not yet had opportunity to pass directly upon it, and it remains purely academic. Professor Odronaux, in his "Jurisprudence of Medicine," p. 291, indulges in a learned and profound discussion of the subject. He does not claim any exclusive right of property in physician, patient, or pharmacist. He is of the opinion that the first has a proprietary right and the second a fiduciary ownership, but does not fix the status of the last. A pharmacist has no right to communicate to others the nature and ingredients of a prescription, for that would certainly fall within the spirit of the law which holds sacred the communications between professional men and their patrons. Justice Yates, in Mills *vs.* Taylor, 4 Burr. 2362, said that ideas are free, and every man has a right to keep them, and a right to make public and control their publication.

In Abernethy *vs.* Hutchinson, 3 L. J. ch. 209, a lecture was held to be the private property of its writer, whose publications he could enjoin. In Gee *vs.* Pritchard, 2 Swan, 402, a letter written to a friend was thus protected. In Morrison *vs.* Moat, 9 Hare, ch. 241, the publication of a secret in the compounding of a medicine was prevented. In England, in Yovatt *vs.* Wingard, 1 J. & W. 394, in 1820, an injunction was granted against making any use of or communicating certain recipes for veterinary medicines. Wingard, while employed by Yovatt, had access to his prescription-book and copied them. Lord Eldon granted the injunction, upon the ground that there had been a breach of trust and confidence. In these days of intellectual activity in various directions, when the press and modern inventions make private actions public property, the right to privacy has come to be recognized as a personal right, of equal claims to the protection of the law with the time-honored rights to life, limb, and property. The courts will prevent a breach of confidence or trust, and what might be termed an implied contract not to publish the results of mental processes intended solely for the benefit of him who seeks and compensates for their aid. The patient may be said to own the prescription, because he paid for it. The apothecary owns it in so far as he has a right to its retention in self-protection against charges of unskilful compounding or use of improper ingredients. The prescription itself is *functus officio*. A physician might print the words "Not to be repeated" across the face of the prescription,

ınd thus raise an implied contract not to use it again. The prescription-ıook is the property of the pharmacist against all the world but physician nd patient, and he should in all cases insist upon the retention of the riginal, and not of a mere copy. I understand that it has been held in Iassachusetts that the sale of prescription-books can be restrained, and ıat they are not subject to sale on execution to satisfy creditors' claims.

A prescription cannot be used again if the physician forbid it. In New 'ork, by the laws of 1887, ch. 636, refilling more than once prescriptions of pium or morphine, or preparations of either, in which the dose exceeds ne-twentieth of a grain, except upon the verbal or written order of a hysician, is made a misdemeanor. If a patient puts up a prescription as a atent medicine and advertises it in the name of a physician, he might be able to an action for libel. (Clark *vs.* Freeman, 11 Beav. 112.)

If a physician prescribes an overdose of a poisonous drug, and the drug-ist, noticing that fact, calls upon the physician, who directs him, notwith-tanding, to dispense it, and the patient sustains bodily injury, or dies in onsequence of the drug, both physician and druggist would be liable, though he latter in a lesser degree. The law does not compel a druggist to fill very prescription presented, any more than is a physician compelled to reat every one who comes to him. If, then, a druggist, despite his con-iction as a professional man of its dangerous character, compound such a prescription, he too assumes a share in the risk, and must abide by the consequences. His remedy is to refuse to fill it. It is his duty to be upon his guard against errors, and he compounds them at his peril.

In Massachusetts a joint action was sustained against physician and drug-gist, because of an erroneous prescription written by the one and filled by he other. (2 Hilliard on Torts, p. 297, note *a*.) As Judge F. C. Brew-ter said in Commonwealth *vs.* Bauer, Philadelphia Oyer and Terminer, April, 1869, "If the exercise of reasonable care would have warned him hat he was preparing something which would inevitably kill, it would be riminal for him to go on." But the negligence of the druggist must be stablished affirmatively. Mere inference will not suffice. The circum-tances of each case must, however, be consulted. No universal rule can e formulated. But negligence has been declared to be the omission to do omething which a reasonable man, guided by those considerations which rdinarily regulate the conduct of human affairs, would do, or the doing of omething which a reasonable and prudent man would not do.

A druggist is often called upon to act *quasi* in the capacity of a physician. e runs the risks of prosecution if he does so. In later days such cases ave become fewer, and the frequent prosecutions of the county medical ocieties have had beneficial results. On the other hand, they have, with e aid of stool-pigeons, often worked grievous wrong. But, as Judge awkins says in Apothecaries *vs.* Jones, 5 R. 101, "It is idle to lay down a olden rule upon the subject." The demarcations of each case must be oted, and the degree of liability becomes a question of fact.

The pharmacist is liable in damages for all injuries inflicted through his ignorance, unskilfulness, or carelessness. He must know, *ex professo*, the properties of medicines and the proper doses, be fully equipped with the knowledge required by the standards of his profession, and keep abreast with the developments of materia medica in so far as they may come into service in modern pharmacy. The law does not require him to be an expert, but he will be held to warrant the purity of the drugs he employs in filling prescriptions, and that they are of the quality called for by the physician. (*Vide* Odronaux's "Jurisprudence of Medicine," p. 259.) He must be conversant with the language of prescriptions and the means for detecting the quality of drugs. He must not grow rusty in his knowledge, and the discoveries of the properties of nature's forces, together with the wonderful disclosures of modern chemistry, must not be "a hidden book" to him.

A leading case in our State is that of Thomas *vs.* Winchester, 6 N. Y. 397. It was decided by the Court of Appeals in July, 1852. A jar had been labelled "One-half pound dandelion, prepared by A. Gilbert, No. 108 John Street, New York. Jar 8 oz." Gilbert was in the employ of Winchester, and the labels were paid for by the latter, and used in his business with his knowledge and assent. The jar was sold to James S. Aspinwall, a druggist in New York, as containing extract of dandelion. As a matter of fact, it contained extract of belladonna. He sold it to Dr. Foord, a druggist in Cazenovia, Madison County, N. Y. Mrs. Thomas had been taken ill, and her physician prescribed extract of dandelion. Her husband went to Dr. Foord's drug-store, and was given some of the contents of the jar in question, in the belief that it contained extract of dandelion. Mrs. Thomas took the medicine according to prescription, and as a result her life was endangered. Upon recovering, she brought an action for damages against Winchester, the original seller. She obtained a verdict and the wholesaler appealed. Chief-Justice Ruggles declared that "the remote vendor of medicine upon which he has carelessly put a wrong label, and which, so labelled, he puts upon the market, is liable for injuries resulting therefrom. This is so, although there be no privity or connection between such vendor and the person injured by its use. Every man is bound under the law to avoid that which endangers another." The court dwells upon the danger to the public because of unskilfulness or carelessness in the profession, and, though there was no contract between the patient and the wholesaler, an implied contract was declared to necessarily exist, because of the danger to the public from mismanagement in the business. So in England a chemist who negligently sold laudanum as paregoric, and caused the death of the person who took it, was declared guilty of manslaughter. (Tessymond's Case, 1 Lewin's Crown Cases, p. 169.) In Kentucky druggists were held liable for selling cantharides for snakeroot and Peruvian bark, and croton oil for linseed oil. (Fleet *vs.* Hollenkamp, 13 B. Munroe, 219; Hanford *vs.* Payne, 11 Bush, 380.) In Michigan the druggist was held for his clerk's mistake in giving sulphate of zinc for Epsom salts. (Brown *vs.* Marshall, 47

Iich. 576.) But a druggist is not responsible for the results, though he ells a poisonous drug without labelling it, if in fact he warned the customer f its properties, and the jury must pass upon the competency of the clerk, nd whether actual negligence was proved.

Mary Wohlfart sued Druggist Charles A. Beckert for damages for negli-ence, because his clerk had given her deceased husband a poison without e usual label. The clerk had warned him that the "black drops" asked r was a strong poison, of which he should take only ten or twelve drops r a dose. He took ten times that amount, relying upon a friend who had ld him he had taken half a glass of what he called "black draught," and at it had cured him. It was admitted that the label was not on the vial. he court held that even though it is a misdemeanor to sell a poison without label, doing so does not render the druggist liable in a civil action, if, efore delivering it, he fairly and fully warned him that the substance was oison. (Wohlfart *vs.* Beckert, 12 Abb. N. C. 478.)

In Brown *vs.* Marshall, 47 Mich. 576, and Beckwith *vs.* Oatman, 43 Iun, 265, it was held that a failure on the part of the druggist, or his clerk, rom whom the medicine was purchased, to exercise due skill and care must e proved. Judge Cooley stated in the Michigan case that a high degree of are may justly be required, but that the courts have not yet gone so far as o dispense with proof of actual negligence as a necessary element in the iability when a mistake has been made. Our Court of Appeals, in Allen *vs.* State, S. S. Co., 132 N. Y. 95, where a passenger sought to make the com-any liable for a mistake in the filling of a prescription aboard during the oyage, having been given calomel instead of quinine, though no actual egligence was shown, held that a person is not legally responsible for any nintentional injury from a lawful act when the failure to exercise due care nnot be imputed to him, and the burden of proving such lack of care when e act is lawful is upon the plaintiff. (Losse *vs.* Buchanan, 51 N. Y. 476, 38; Carpenter *vs.* Blake, 75 N. Y. 12; Morris *vs.* Platt, 32 Conn. 75; mond *vs.* Henry, 39 Me. 155.)

A man without a license may invest his money in a pharmacy, but cannot mself sell or dispense medicines. (Commonwealth *vs.* Johnson, 144 Pa. . 377; Commonwealth *vs.* Johnson, 22 Atl. 703; State *vs.* Morton, 67 wa, 641.) In New York a conviction, in January, 1889, for opening and nducting a pharmacy for compounding and retailing medicines without e qualification according to law was sustained by the courts. (People *vs.* ontey, 21 N. Y. St. R. 174; 4 N. Y. Supp. 235; 117 N. Y. 624.)

A physician's prescription is in itself no defence if the druggist has no ense. (Druggists' Cases, 85 Tenn. 449; Liquor Case, 37 Am. R. 284.)

In Georgia it has been held that whiskey is not a drug. The court said, We are old-fashioned and perhaps ignorant of the expansion of many ords in modern use, among them the word 'drug.' It carries along with an idea inseparable from it, of something repulsive, nauseous, at which the orge heaves. Whiskey, on the contrary, is inviting, exhilarating."

It was also urged that goods hard to sell are often called a drug, and, therefore, to call whiskey, proverbially so easy to sell, a drug would be, in the language of the court, "a palpable misnomer." (Gault *vs.* State, 34 Ga. 533.)

One who sells and prepares drugs for medicinal purposes has been held to be a druggist. (Anderson *vs.* Commonwealth, 9 Bush, 571.)

It has been asked whether a proprietor is liable for damages when his clerk commits an error, the clerk being licensed. From the cases already cited, such would seem to be the law. There is force, however, in the suggestion that when a board of pharmacy issues a license to an applicant, and sends him forth into the world as a duly qualified druggist, such boards of pharmacy and their licentiates, rather than an employer druggist who relies upon such certificates of qualification, should be held responsible for the consequences of the ignorance or unskilfulness of the employee. In State *vs.* Donaldson, 41 Minn. 74, it was held that the sale of borax by one not a pharmacist was not prohibited. But in Cook *vs.* People, 125 Ill. 278, the term "usual remedies" was defined as not including quinine. These peculiarities must be relegated to the language of the statute in question in each case.

Gwynn applied to Druggist Duffield to compound a prescription calling for rhubarb. The latter took belladonna instead from a jar, itself properly labelled. Gwynn, standing by, put his finger in it, took a small quantity from it, and asked, was that a proper dose? The druggist answered affirmatively. Gwynn took it and suffered. The court held that he was guilty of contributory negligence in himself taking it from the jar, and absolved the druggist. (Gwynn *vs.* Duffield, 61 Iowa, 64; s. c., 47 Am. Rep. 802; 66 Iowa, 708; 55 Am. Rep. 286.)

If a druggist fills a prescription improperly, he cannot raise the defence that the case itself was negligently treated. (Brown *vs.* Marshall, 47 Mich. 576; s. c., 41 Am. Rep. 728.) A pharmacist had recommended a prescription in good faith which had been given to another. The customer ordered it and the druggist furnished it, charging only for the medicines and their compounding. The customer sustained injury and sued the druggist, but the court held that he was not responsible. (Ray *vs.* Burbank, 61 Georgia, 505; s. c., 34 Am. Rep. 103.)

The safe course for a druggist when a customer calls for a remedy is to give him what he may say he has been recommended to take, and so asks for, but not to undertake himself to diagnose and prescribe for the case. Where a druggist sells an article in itself harmless, but which in combination with other articles becomes dangerous, and is not informed that it is to be used in such combination, he is not liable for any damage that may result. (Davidson *vs.* Michels, 11 Allen (Mass.), 514.)

A druggist sold a deadly poison as a harmless medicine to a man who bought it to administer to another, who died after taking it. His widow was held to have a right of action against the pharmacist. (Morton *vs.* Sewell, 106 Mass. 143; s. c., 8 Am. Rep. 298.)

The statute provided that "it should be unlawful for any person not a registered pharmacist to conduct any pharmacy or drug-store." It was held to be no defence that the sales were made by a clerk who was a registered pharmacist. (State *vs*. Morton, 67 Iowa, 641.)

A policy for fire-insurance covered drugs and medicines, and provided hat it should be void "if the insured shall keep gunpowder, fireworks, saltetre, etc." It was held that this did not forbid the keeping of saltpetre as drug, but only keeping it in such quantity and manner as not to increase e risk. (Collins *vs*. Ins. Co., 281 ; s. c., 28 Am. Rep. 322.)

Every pharmacy has some remedy of its own make. Often it is herded as a cure for every disease. The domain of proprietary medicines is actically limitless. Humanity, always eager to escape its hereditary ills, eedily clutches at every compound that promises relief. The dealer is posed to the danger of suits for damages for infringements. A medicine usually patented by copyrighting the label, using a distinct trade-mark or ame. The formula thus is not exposed, yet any infringement can be reressed. The mere name of a man is not the subject of a trade-mark. A roprietary medicine must not, however, be put up in such colorable imitaon of another as to be calculated to mislead an ordinary purchaser. The ases in the books upon the subject are too numerous for citation, but that is he pith of the decisions. . . . The question of the power of the New York ire Department to collect an annual fee of two dollars for the manufacture, torage, or keeping for sale of certain combustibles was answered in the ffirmative in 1884. Gustavus Miller was sued for a penalty for keeping ther on sale without a permit. The Court of Common Pleas, through Chiefustice Daly, after a review of the authorities, held that the regulation was properly made by the Board of Fire Commissioners in the exercise of the police power for the security and safety of the citizens. (Mayor, etc., *vs*. Miller, 12 Daly, 496.) I cannot find that the case was ever taken to the court of last resort.

APPENDIX

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APPENDIX

ILLUSTRATIVE CASES.

FAMOUS POISON CASES.

In the year 1872, Mary Anne Colton was executed at Durham, England, for having poisoned sixteen children.

Dr. Pritchard, of Scotland, was hanged at Glasgow in 1865, after making a confession of having slowly poisoned his wife and mother-in-law by means of antimony.

Dr. William Palmer, of Staffordshire, England, poisoned his wife, his brother, and a friend, Mr. Cook, for the purpose of obtaining their life-insurance. Strychnine was the substance employed to effect his purpose; but the medical experts were unable to discover any trace of the poison in the body of Cook, for whose death alone the criminal was tried. No suspicion attached to him in the other cases, and it was not generally known that he had been the cause of the death of his wife and brother until he made confession of his crimes on the scaffold. His conviction in the other case was principally on account of his excessive nervousness, together with his peculiar actions during the trial. After the jury had rendered the verdict condemning him to death, he strenuously protested his innocence, and it was not until the very last moment, after he had exhausted all means of escaping death, that he confessed everything.

In 1815, Eliza Fenning, a servant, was executed on the charge of having been instrumental in poisoning an entire family with poisoned dumplings. None of her victims died, and the criminal partook of the dumplings herself, suffering, as a result of her act, with exactly the same symptoms as the others. She was, however, convicted of the crime. Many persons believed in her innocence, and a great number of petitions were forwarded to the king, requesting her pardon, but by the advice of the judge who presided at the trial the petition was rejected. "It did not take much to convict a man or woman accused of this crime in the eighteenth century. A famous case in point is that of Captain Donellan, in England, who was hanged on the supposition that he poisoned his brother-in-law, whose heir he was. The principal evidence against him seems to have been that he had a motive for the alleged crime. The brother-in-law, Sir Theodosius Boughton, was in poor health, and Captain Donellan was living with him and occupying adjoining rooms. Sir Theo-

dosius took, as he supposed, some medicine for which he had sent to the apothecary, and shortly afterwards he died in great pain. Captain Donellan insisted upon rinsing out the bottle, which afterwards retained an odor of bitter almonds. Physicians testified that the liquid might have been laurel-water, a poison having such an odor, and on their evidence Captain Donellan was convicted."

Dr. Graves killed his victim at long distance by means of poisoned whiskey, forwarded through the mails.

Poisoning by Antimony.—"Mr. Bravo, a weak, vain man, met Mrs. Ricardo, then a wealthy widow, and speedily married her. According to her statement, she told him before marriage that she had been on too intimate terms with a Dr. Gully, well known at Malvern. It is certain that Mr. Bravo knew of this connection, and that it rankled in him, nor does he seem to have been sparing in letting his wife know this. At all events, the facts connected with his miserable death are here embodied. Mr. Bravo was a young barrister of about thirty, strong, healthy, and hearty. He had hardly ever suffered from ill health, was a remarkably cheerful man, and of temperate habits. On Tuesday, April 18, 1876, after breakfast at his own house at Balham, he drove with his wife into town. On their way, according to her statement, they had an extremely unpleasant conversation. He had a Turkish bath, lunched with a relation of his wife's at St. James Hall, and walked on his way home to Victoria Station with a friend and fellow-barrister, whom he asked out for the following day. He arrived at home about half-past four. Shortly after his return home, Mr. Bravo went out for a ride, in the course of which the cob on which he was riding bolted with him and carried him a long distance. From this he returned tired, ill, and exhausted. When seen at half-past six, Mr. Bravo was sitting, leaning forward on his chair, looking ill, and with his head hanging down. He ordered a hot bath, and in moving to get it he cried out very loud with pain and put his hand to his side. After his bath he did not appear very much better, but seemed to suffer pain all through the time of dinner, though he seemed to avoid attracting the attention of his wife and Mrs. Cox, her companion, who dined with him. The dinner hour was half past seven, but from certain causes it was delayed for a few minutes. The articles composing the food eaten at dinner were partaken of more or less in common by all three. As regards drink, this was not the case. Mr. Bravo drank Burgundy only; Mrs. Bravo and Mrs. Cox only sherry and Marsala. Burgundy was the wine Mr. Bravo usually drank, and this had been decanted by the butler some time before dinner, how long he could not say. The butler noticed nothing unusual in the wine; and Mr. Bravo, who would only drink wine of a good quality, and who seemed, moreover, a connoisseur in wine, remarked nothing as to its taste and quality, but drank it as usual. The quantity of wine he commonly took at dinner was about three or four glasses. If he had Burgundy for luncheon, he finished the bottle at dinner; but if not, as on the day in question, the remains of the bottle were put aside in an unlocked cellaret

in the dining-room. Whether or not any wine was left after dinner on this day could not be found out; the butler could not remember. At all events, no remainder of the wine then consumed was discovered. This cellaret was opened at least twice subsequently to this and prior to Mr. Bravo's illness, —once by Mrs. Cox and once by the housemaid.

"As regards the food itself, Mr. Bravo seems to have eaten fairly well. It was clear, therefore, that the adventure on horseback had not completely destroyed his appetite; but it is also clearly in evidence that he was not himself, from whatever cause. It was said he had been suffering from toothache and neuralgia, and he had just received a vexatious letter. Here the element of time assumes a greater and greater importance. There was no reason to believe that Mr. Bravo had swallowed any poison up to half-past seven o'clock or twenty minutes to eight. The dinner lasted till past eight; there was some talk, and then the three people who partook of dinner passed into the morning-room, where conversation was continued up to about nine o'clock. Mrs. Bravo and Mrs. Cox went upstairs, leaving Mr. Bravo alone, and Mrs. Cox went to fetch Mrs. Bravo some wine and water from the dining-room. Upstairs Mrs. Bravo undressed and made ready for bed, Mrs. Cox still being with her, and she drank the wine and water brought up.

"The next point of time was exactly fixed. The housemaid was accus-omed to take up every evening some hot water for washing before the adies went to bed. On this occasion the bell did not ring, and the house-aid, looking at the clock and finding it half-past nine, of her own accord roceeded to take up the hot water. Mrs. Bravo then asked the girl to tch her some Marsala, which she proceeded to do, taking the glass which ad contained the wine and water for that purpose. On her way back to he dining-room she encountered her master at the foot of the stairs. He ooked 'queer,'—that is, 'he looked very strange in the face, but did not ppear to be in pain.' He looked twice at the servant, yet did not speak, hough that was his custom, but passed on. She thought 'perhaps he was ngry.' Mr. Bravo was alone after the departure of his wife and Mrs. Cox, ntil the time when he passed upstairs before the housemaid. He entered his ife's dressing-room, and the maid Mrs. Bravo's bedroom. In the dressing-oom, according to Mrs. Cox's statement, Mr. Bravo spoke to his wife in rench, upbraiding her for taking too much wine. This had frequently been he subject of unpleasant remarks before, but Mrs. Bravo did not remember is saying anything on this occasion. This must have brought the time own to twenty minutes or quarter to ten. After this Mr. Bravo left his ife's dressing-room, went to his own bedroom, and closed the door. The aid left Mrs. Bravo's bedroom, and met Mrs. Bravo in the passage, un-ressed, and on her way to bed. The interval between the point of time hen Mr. Bravo left his wife's bedroom and entered his own and the next oint in the history of the day is not easily measured. This helps. The aid had time to collect and put away Mrs. Bravo's day apparel, to enter Irs. Bravo's bedroom, where she had a few words of conversation with Mrs.

Cox, who was sitting at the bedside, to leave the room and reach the foot of the stairs leading to Mrs. Cox's own bedroom upstairs, when the door opened, and Mr. Bravo, in his night-shirt, shouted out, 'Florence! Florence! hot water!' All this could hardly have been done in less than a quarter of an hour; but after this, for some time, confusion reigned supreme. The maid ran into Mrs. Bravo's room, calling out that Mr. Bravo was ill. Mrs. Cox, yet dressed, hastily rose and went in to him. She found him standing at the open window, apparently vomiting, and this the maid also saw. Mrs. Cox stated that Mr. Bravo said to her, 'I have taken poison for Dr. Gully; don't tell Florence' (his wife); and to this confession of having taken poison, on the part of Mr. Bravo, Mrs. Cox adhered throughout. After this Mr. Bravo vomited, and some hot water was brought by the maid. After vomiting, Mr. Bravo sank on the floor, became insensible, and remained so for some hours. Mrs. Cox tried to raise him, and procured for him some mustard and hot water to make him sick; but this he could hardly, if at all, swallow. Mustard was also applied to his feet and camphor liniment to his chest. After the mustard and water he again vomited in a hand-basin. The vomited matters 'looked like food, and were red.' These were unfortunately thrown down the sink and so disposed of. Meanwhile, coffee had been procured, but Mr. Bravo was unable to swallow. On the first alarm, Mr. Harrison, a practitioner, who had previously seen Mrs. Bravo, was sent for, but he lived at some distance. Mrs. Bravo, who had been roused from sleep by the maid, and who seems to have been greatly excited, insisted on a nearer practitioner being sent for, and in no long time Mr. Moore, a practitioner residing not very far off, arrived. Here again we have a point of time fixed. Mr. Moore arrived about half-past ten, and from this time the history assumes a more scientific aspect. As already said, Mr. Bravo became insensible almost immediately after being seen by Mrs. Cox and the maid, but about this insensibility there seems to have been a good deal of misconception. Mrs. Cox rushed at the conclusion that Mr. Bravo had swallowed laudanum, chloroform, or some narcotic, and to this end had given the mustard and water to get rid of the poison, and the coffee to obviate its effect. The insensibility was not due to narcotism; it was the insensibility of utter collapse, of almost complete syncope. Mr. Moore, on his arrival, found the patient sitting or lying on a chair. He was completely unconscious, the heart's action was almost suspended, and he was almost pulseless. His pupils were dilated. Mr. Moore caused him to be laid on his bed, and tried to give him some hot brandy and water, but he could not swallow. In twenty minutes or half an hour Mr. Harrison arrived. He was met by Mrs. Cox, who said she was sure Mr. Bravo had taken chloroform. This was taken in the sense that the chloroform was in a poisonous dose. Both Mr. Harrison and Mr. Moore early came to the conclusion that their patient was in a most dangerous state, and that in all probability he would not recover from the collapse from which he was then suffering. They, however, tried to administer stimulants, first by the mouth; but that failing, they gave him

an enema of brandy and water. Seeing the dangerous nature of the case, other medical aid was suggested, and Mr. Royes Bell, cousin of the deceased, was sent for, with a request to bring some physician with him. He brought Dr. George Johnson, of King's College Hospital, and the two arrived at Balham about half-past two. Meanwhile, the case began to clear up. About two o'clock Mr. Bravo 'began to vomit a bloody fluid;' the pulse rose, and he passed a bloody fluid in bed. There could no longer be any doubt that the patient was suffering from the effects of irritant poisoning. Mr. Bravo had thus been as nearly as possible four hours without any other symptom of poisoning than profound collapse.

"Shortly after the arrival of Dr. George Johnson and Mr. Royes Bell consciousness began to return, and at three o'clock Mr. Bravo was again conscious and able to be questioned. Soon after the arrival of these two gentlemen, Mrs. Cox requested an interview with Mr. Bell, and then told him that Mr. Bravo had said, 'I have taken poison; don't tell Florence.' Mr. Bell, who seems to have been somewhat angry at this tardy statement on the part of Mrs. Cox, summoned Dr. Johnson, who also heard it; so that when Mr. Bravo returned to consciousness, almost the first question asked of him was, 'What have you taken?' From first to last—and this is an important feature in the case—the dying man (for he early felt that he was doomed) persisted in declaring in the most solemn manner that he had taken nothing except some laudanum for toothache. Yet he expressed no surprise at being thus taken ill, though he knew quite enough of medicine to appreciate the effects of opium, and to know that they were very different from those under which he was suffering. At an early period Mr. Bravo's bedroom was searched, but nothing was found save the laudanum-bottle, a little chloroform, and camphor liniment, which had been brought from another room. There were no remains or indication of any solid poison, no paper or anything else which could have contained it, no traces of a dirty tumbler or drinking-glass,—in short, nothing. It must, however, be remembered that great confusion had prevailed; that many things, including vomited matters and dirty glasses, must have been removed; and that a fire was burning in Mr. Bravo's room. Mr. Bravo himself, on being questioned, mentioned, as poisons in the place, the laudanum, the chloroform, Condy's fluid, and 'rat poison in the stable.' After recovering consciousness, Mr. Bravo did not again lose it to the time of his death. He remained collapsed; suffered fearful pain; vomited and purged matters of various descriptions; was severely convulsed, especially in his upper extremities; but he remained conscious throughout. On Friday morning, at half-past two, the vomiting and purging ceased, and at half-past five Mr. Bravo died, having thus been fifty-five and a half hours ill. On Saturday, the 22d, Dr. Payne, of St. Thomas's Hospital, made a post-mortem examination of the body. 'There was no appearance of inflammation, congestion, or ulceration. The stomach contained about eight ounces of thick, gruel-like matter, of a yellowish color, containing small solid lumps, and had the odor of alcoholic fermenta-

tion. The œsophagus or gullet was natural, and contained some of the same matter as the stomach. The first portion of the bowels was very soft, being torn in tying it, but subsequent careful examination showed no perforation or ulceration. The surface was pale and yellowish, like that of the stomach. The whole of the small intestine was like this, except the lower part, where there were some red spots. This part of the bowels contained yellow, pasty matter, without any admixture of blood. The large intestine at its commencement was of a deep-red color, and contained clots of blood. Subsequent examination showed, in the portion called the cæcum, very small ulcers, from which the bleeding had evidently taken place, but there was no perforation. The remainder of the large intestine was very deeply blood-stained, but without ulceration. The contents were soft, dark-red material, composed of fæcal matter mixed with blood. The liver and spleen were natural, as were also the pancreas, kidneys, and other abdominal organs. There was no appearance of hernia or rupture. On opening the head, the skull and the membranes of the brain were found quite natural, and contained no excessive amount either of blood or of watery fluid. The mouth and lips were natural, except that the papillæ at the back of the tongue were somewhat more prominent than is usual. There was no other appearance of disease in the body except what has been noted.' Such is the medical history of this extraordinary case; but it would be incomplete without some account of the chemical examination, which was made by Professor Redwood, of the Pharmaceutical Society. Most extraordinary to relate, the matters which were vomited at the very beginning of the attack of illness which proved fatal to Mr. Bravo remained undisturbed on the leads of the house from Tuesday night till Thursday, and they were seen both by Dr. Johnson and Sir William Gull. On that day they were directed to be removed, and they were handed over to Professor Redwood. Meanwhile, much rain had fallen, and a great part of the vomit, especially the liquid matters, had been washed away. No doubt in this way a large quantity—probably the larger quantity—of the poison had been lost. Nevertheless, in the vomit a great amount of antimony was discovered. Antimony, too, was discovered in the contents of the great gut after death, in the liver, and in smaller quantities elsewhere. Altogether, the conclusion come to was that something like forty grains, at least, had been swallowed. This estimate, nevertheless, must be far under the mark; for, if we bear in mind the quantity passed in the stools and the quantity of antimony left in the tissues, over and above that detected and estimated, it is clear that an enormous dose had been taken. That being so, the conclusion must be that the poison had been swallowed after half-past eight, when the party adjourned to the morning-room; probably after nine, when Mrs. Bravo and Mrs. Cox went upstairs, and very likely, indeed, after Mr. Bravo himself had retired to his bedroom. This last notion is by far the most likely. A large dose of antimony had been taken; sickness followed in a few minutes. Mr. Bravo, feeling this, shouted for hot water, and so great was the prostrating effect

of the antimony that in a few minutes he fell to the ground utterly collapsed. During the period of collapse and unconsciousness, which lasted from ten o'clock till three, but little of the poison would be absorbed, and thus all the more would be ejected in the matters vomited just after. The post-mortem condition was most extraordinary. That there was great gastric irritation at one time was evidenced by the vomiting of bloody matters, to which Mr. Harrison and Mr. Moore bore testimony; but that must have been completely overcome before death. Apparently the irritation and inflammation gradually extended downward, leaving the upper portion of the bowel profoundly damaged, but presenting no signs of active and recent inflammation. The only verdict which ought to have been come to was that Mr. Bravo died from the effects of antimony, for there was no very reliable evidence to show whether the poisoning was suicidal or homicidal. Probability inclined strongly to the former."—"Memoranda of Poisons," Tanner.

The Wharton Case.—"The whole question of the tests for antimony was worked over most carefully in connection with this famous case. In 1872, Mrs. Wharton, a member of a well-known and prominent Maryland family, was tried for the murder of General Ketchum. The latter had been taken violently ill while visiting at her house, and died under rather suspicious circumstances a few days later; while, at the same time, another friend of the family had suddenly fallen ill and nearly died, after taking some refreshments in the same house. In both cases there were various money transactions which might have acted as an inducement for a crime, and also, in both cases, suspicious-looking sediments were found in liquids given the invalids by Mrs. Wharton. The symptoms of General Ketchum and the post-mortem condition of the body were consistent with, though not especially characteristic of, antimony-poisoning, so the case turned entirely upon the chemical evidence.

"The latter indicated the presence of tartar emetic in considerable quantities in both the liquids mentioned and in the stomach of General Ketchum. But unfortunately in every case the original solutions and the resulting precipitates were thrown away, so that, when the tests were disputed, it was impossible to confirm them. The principal chemical witness for the prosecution testified that both the sediment in a glass of milk-punch and the contents of the stomach gave a brownish-red precipitate with sulphuretted hydrogen, after acidifying with hydrochloric acid; that this dissolved in boiling hydrochloric acid; that this solution, when diluted with large amounts of water, gave a white precipitate, which dissolved in tartaric acid, and gave an orange-red precipitate when the tartaric acid solution was again treated with sulphuretted hydrogen. The above tests are a pretty certain indication of the presence of antimony, but they were not confirmed by any others, except by a very unsatisfactory Marsh's test, made by another chemist. Nor were any of the precipitates saved or shown in court, although the amount of tartar emetic in the stomach was estimated roughly at twenty grains.

Besides this, no attempt was made to remove any, far less all, of the organic matter before making the tests. This carelessness ruined the case, for several experts were brought in to testify that the metal itself, under those circumstances, should have been produced. They even went to the extreme of making up a solution of gelsemium extract, chloral, beef-tea, white of egg, and milk, which they claimed was a fair reproduction of the contents of General Ketchum's stomach after death, and by using nearly though not quite the same steps produced results which to the jury seemed to agree more or less closely with those produced by antimony. In short, they fought so hard that the jury disbelieved the chemical evidence on the other side, and accordingly acquitted the prisoner. Whether the testimony of some of the experts did not overstep the limits of scientific and impartial evidence is an open question ; but there is absolutely no doubt that, in any case of this sort, a chemist is unpardonably careless unless he saves with the utmost care everything submitted to him, and preserves and brings into court, if at all possible, every particle of poison that he can isolate."—Pellew, in Hamilton's "System of Legal Medicine," vol. i. p. 347.

Arsenic-Poisoning.—"One of the most rapid cases of arsenic-poisoning ever reported is given by Dr. Finley.[1] A healthy man, aged fifty-one, had drunk by mistake, upon an empty stomach, a solution containing about twenty-six grains of arsenic. He was taken almost at once with faintness and collapse, with some epigastric pains. He was brought to the hospital in about half an hour, and had not yet vomited. His symptoms were cold skin, a free, clammy sweat, feeble and slow pulse, shallow respiration, pupils moderately dilated. He was still conscious, and complained of headache, constriction across the chest, and pain in the epigastrium. Emetics did not work ; they washed out the stomach, but without effect. He was put to bed, given brandy, hot-water bottles, warm blankets, and rest ; but in spite of everything he sank rapidly, became pulseless, and died in one hour from the time he took the poison. Post-mortem examination showed intense congestion of the trachea and larynx. The intestines, spleen, and heart were normal, except for an ecchymosis on the endocardium of the left ventricle. The liver and kidneys were congested, and arsenic was found in the contents of the stomach, the tissues, and in the liquid remaining in the bottom of the bottle."—Pellew, in Hamilton's "System of Legal Medicine," vol. i. p. 361.

The Jennie Cramer Case.—Some of the medical points in connection with this famous case are as follows. "Jennie Cramer was found dead in the water near the beach, and sufficient arsenic to kill was recovered from her body. Under such circumstances the questions to determine are whether the body was thrown into the water after death by arsenic or whether drowning was the mode of dying. The testimony for the State was with unanimity in favor of the former proposition. Without presuming to decide this point, we may at least attempt to ascertain how far the statements of

[1] Lancet, 1883, part ii. p. 943.

the witnesses are supported by medico-legal authorities. Dr. Prudden, who onducted the autopsy, said there were none of the usual indications of death y drowning. Frothing at the nose and mouth; frothy mucus in the air-assages; goose-skin (*cutis anserina*); sodden hands (washer-woman); linched hands, sometimes holding firmly grass, sand, or other objects seized the final struggle; water in the bronchial tubes and lungs, which may ntain sand, mud, or other substances indicating whence derived, and also e same in the gullet and stomach; the veins of the brain, the great venous unks, and the right cavities of the heart distended with black blood, while e left cavities are empty, are the conditions present after death by drown-g. Dr. Prudden disclaimed the opinion that any single sign is conclusive, d rightly held that it is the coincident occurrence of them all which must any case determine. In this position he is supported by the medico-legal iters. Of these the American Beck and the German Casper have almost eated the subject in its modern aspect, and have furnished the facts and inions upon which succeeding authors have depended. Beck's description drowning is classic, and affords a clear conception of the mechanism of e lesions.

"The most interesting subject from the scientific point of view is the isoning by arsenic. Professor Chittenden, who conducted the examina-n, gave a luminous account of the processes employed, and exhibited the ison to the court and jury. His estimate, based on an examination of fferent parts, was that three grains and a fraction (3.1192 grains) was the nount present in the body at death. From two to three grains, under cir-mstances favorable to the operation of the poison, may be assigned as a tal dose in an adult. Very large doses—from sixty grains to two ounces—ve been taken and recovered from; but such doses were received on a ll stomach, and quickly ejected by vomiting. Does arsenic in a toxic dose variably produce inflammation of the stomach? Although inserted at any int, it may cause inflammation of the stomach by virtue of a selective tion; this is by no means an invariable result, even when the dose is a ge one. There have occurred cases in which, without vomiting and rging or gastro-intestinal inflammation, paralysis, coma, and insensibility ve supervened. Much depends on the form in which administered. hen arsenous acid, undissolved, enters the stomach, absorption is slow, ving time for the local action of the crystals embedded in the folds of the ucous membrane. As, however, inflammation of the stomach occurs when senic is introduced elsewhere, there must be another factor of unknown igin, the presence or absence of which affects the result. Dr. Prudden on is point testified that inflammation of the stomach was not an invariable ect of arsenical poisoning, and quoted statistics in which inflammation was sent in the proportion of thirty-six to one hundred and eighty-five, or in e-fifth of the cases.

"Several important questions arose about the absorption or diffusion of senic. Professor Chittenden testified that the form in which it entered the

stomach materially affected the result. In solution, as arsenite of potassium, or Fowler's solution, diffusion into the stomach-veins occurs more quickly than when it enters the stomach as solid arsenous acid. When the solution is taken, symptoms of poisoning may appear within a half-hour; when the solid is taken, a delay incident to the process of dissolving occurs, and hence the distinctly toxic effects may be postponed to an hour. The emetic effect due to a large dose, received on a full stomach, should not be confounded with the systemic toxical action. No evidence has appeared in regard to the character of the symptoms experienced by Jennie Cramer. Professor Chittenden assumes that a soluble preparation of arsenic was taken, because there were no crystals of arsenous acid adherent to the mucous membrane of the stomach, and because the poison was so widely diffused, being found in unusually large proportion in the brain, and also found in the muscles of the back. There is much to be said in favor of these statements, but they are not entirely defensible. That crystals of arsenous acid, after the administration of the powder, have been picked off the mucous membrane is certainly true. But the difference in the diffusibility and systemic action of arsenic in the solid form and arsenic in solution is one of time. When arsenous acid enters the stomach it obeys the laws of chemical combination, and forms an arsenite with sodium or potassium, and diffuses into the blood in this form. After entering into combination with a base and diffusing into the blood as arsenite, there can be no difference in the distribution throughout the body of the preformed arsenite and the arsenite made in the stomach. The presence of arsenic in the various organs and tissues, except the bones, is proof of the recent introduction of the poison; for so quickly is it eliminated that, if the victim live fifteen or sixteen days after receiving the fatal dose, none of the poison can be detected after death. This was Orfila's conclusion long ago, after a course of careful experiments, and it has been confirmed abundantly since by actual cases. As elimination proceeds, arsenic can be detected in the urine. Excretion occurs, to a greater or less extent, also by the liver. In this organ the poison has been found when it could not be detected elsewhere. When arsenic is administered by the stomach, the liver is the first organ reached after diffusion into the blood has occurred. Poisons are not infrequently delayed in the liver. In this fact we have an explanation, certainly in part, of the extraordinary difference in the action of remedies administered subcutaneously and by the stomach respectively. But the liver, again, filters poisons from the blood and excretes them. Hence it is that poisons are found in the liver in greater proportion than in any other organ or tissue.

"In the case of Jennie Cramer, the reasons assigned by Professor Chittenden for the belief that the poison had been received not more than twenty-four hours before death were conclusive. There was nearly four times as much arsenic found in the fauces, larynx, and trachea as in the kidneys. The quantity found in the stomach and intestines was more than half of the whole amount contained in the internal organs. It is evident, therefore, that

there had not been time to effect the elimination of the arsenic taken; it had begun, but had not proceeded far when death overtook the victim." —*Medical News*, May 20, 1882, p. 545.

The Dr. Henry C. F. Meyer Case.—Dr. Meyer was found guilty of murder in the second degree, for having poisoned one Ludwig Brandt. The case was tried before Recorder Smyth, in the city of New York, May, 1894. The case, briefly, is as follows. "Ludwig Brandt was poisoned in order to obtain the insurance on his life. Dr. Meyer had been engaged in several insurance swindles, one of which landed him in jail in Chicago. While there, he met Carl Müller, Brandt, Gustav Hinrich, Joseph Baum, and 'Jack' Gardner, *alias* Adkins. All these readily entered into a plot by which Meyer assured them of a quick and generous fortune. Baum was released before the others. Shortly afterwards he was imprisoned in Cincinnati for forgery. When Dr. Meyer was released from the Cook County jail he hunted up Müller and Brandt and outlined his plot. Brandt was to impersonate Baum, have his life insured, and then pretend death. Meyer's purpose was to murder Brandt under the name of Baum, and then, if charged with the murder, produce the original Baum alive. Mrs. Meyer was to help them carry out the plot. The conspirators came to New York and hired a flat at No. 320 East Thirteenth Street. Meyer and Müller convinced the unfortunate Brandt that he was to be an equal sharer in the proceeds of the swindle. He was to feign sickness or take drugs enough to produce an illness so realistic as to deceive an experienced doctor, and a corpse should be procured and palmed off on the doctor, and Mrs. Brandt should pass for Mrs. Baum and collect the money. In New York Meyer and Müller found that it was impossible to find a corpse to be surreptitiously substituted for the pretended Baum. They next tried, but failed to get a sick man obliging enough to come and die in their flat. The plotters were about to give up in despair, when Mrs. Meyer, with hysterical tears, declared that the swindle must not be abandoned; that too much money had been spent on it. Thereupon the silly Brandt, who had an infatuation for Mrs. Meyer, consented to make himself ill by taking medicines which would produce a realistic simulation of dysentery, and of his own will he took heroic doses of salts and croton oil; but without his knowledge (confiding, however, in Mrs. Meyer and Müller), Dr. Meyer 'salted' Brandt's food first with antimony and then with arsenic, and the deluded youth—he was only twenty-six—died in agony, believing almost to his last moment that he was helping along a first-rate scheme which would make him rich. When the investigations of the insurance company had revealed these facts the grand jury indicted Dr. and Mrs. Meyer for murder in the first degree. They were captured in Detroit, Michigan, in July, 1893, on the information of Müller, who turned State's evidence."

The prosecution's case was this. "There was a conspiracy to cheat the life insurance companies. For this purpose Brandt was insured under the name of Baum, and he became ill and died. The only evidence that Brandt

was made sick by any one comes from the accomplice, Müller, and his only direct testimony was that the dead man took croton oil, and that against the advice of Dr. Meyer. As to the administration of antimony and arsenic, Müller's testimony was all surmise and guesswork, based on seeing some stuff bearing those names in the doctor's possession, and the man who gave this testimony also by his own testimony admitted himself to be a consummate liar and a criminal of the lowest order, utterly unworthy of belief. The *defence* expected the evidence of the other to weigh so heavily and accord so finely with Müller's testimony that it would carry it through. Nobody else connected Meyer with the case; and although the expert evidence that antimony and arsenic were found in the body in sufficient quantities to kill was not shaken, yet the expert's qualifications were so badly riddled in parts that the defence was clearly of the opinion that the jury would not place much faith in it."

The *hypothetical question* advanced by the prosecution was: "Assume the following facts. A man, twenty-six years of age, died in this city, March 30, 1892. During the month of August, 1891, he had been carefully examined by three physicians in the city of Chicago for insurance on his life, and after a thorough examination he was found to be in perfect health, and was accepted by four different companies. He was temperate in his habits, both as to eating and drinking, and used tobacco in moderation. When he came to New York, in the latter part of February, 1892, he was in the enjoyment of good health. About March 9, 1892, he took two doses of salts. On the same day he visited a physician, to whom he complained of intermittent diarrhœa with slight pains in the abdomen. The physician prescribed powders containing opium and bismuth, but there is no evidence that the prescription was ever put up or taken. On the 11th of that month he took a large dose of croton oil. He complained of pain in his stomach and took to his bed. On the night of the same day he was attended by the same physician, to whom he complained of nausea but no vomiting, excessive thirst, and colicky, griping pains. On examination the doctor found his temperature under the tongue about 102° F., pulse 100, tongue furred and moist, abdomen rigid. He was visited by the same physician every day thereafter until the day of his death, and on two occasions by another physician in company with the first. The symptoms described above continued, and gradually became more accentuated. About the 19th or 20th of March, a white powder, said by the man who gave it to be brechweinstein, or tartar emetic, was frequently seen to be put into his food, and during the last week of his life arsenic, in unknown quantities, was administered to him in the same way. During the last ten days of his life the emaciation of the patient, which had been gradual before, became very marked. He had cold perspirations, his voice became feeble, he complained of pains in the calves of his legs, in his back and head, and burning pains in the eyes. His tongue was red and glazed, his pulse was small and weak, and a day or two before his death he had a temperature of 103° F.

As he approached his death he showed extreme emaciation and prostration. The attending physician had at different times prescribed various remedies, which were purchased but not administered. The body was not embalmed, and was buried in a cloth-covered wooden casket, surrounded with an outer box, in Evergreen Cemetery, April 2, 1892. It was disinterred July 6, 1892, and brought to New York City, where an autopsy was performed. The body was very emaciated, but externally in a fair state of preservation. An examination was made of the organs, but no gross lesions sufficient to account for death were found. The spleen was natural in size, and there was no cirrhosis of the liver. A special examination was made of the intestines for dysenteric ulcerations and lesions of typhoid fever, but with negative results. The heart was normal in size and in general appearance, and the valves of the heart were normal. The kidneys were normal in size and showed no naked-eye lesions, and their capsules were not adherent. The bladder was empty. The organs were too far decomposed to permit of any microscopic examination. The stomach and its contents, the intestines and their contents, the liver and spleen, together with some fluid from the abdomen and thorax, the kidneys, heart, calf of the right leg, were each separately analyzed. Antimony and arsenic were found in each, though in varying proportions to each other. The chemical analysis, as a whole, disclosed the presence of about six to ten grains of antimony, calculated as tartar emetic, and of three to five grains of arsenic, calculated as arsenous oxide. The greater portion of these was found in the alimentary tract and liver, and only a trace of antimony was found in the kidneys and muscle, very little more in the brain, but a larger portion in the heart."

Many expert witnesses for and against the defendant were closely examined by counsel on both sides. The writer testified as an expert for the defence on the questions of *acute and chronic arsenical poisoning*, *acute and chronic antimonial poisoning*, *croton oil poisoning*, *identification of the dead body, and decomposition.*

The Buchanan Case.—"Robert W. Buchanan began life in Halifax, Nova Scotia. He spent several years of his life in a drug-store, where he learned the art of compounding medicines and drugs. From that he easily passed into the study of medicine, prosecuted his studies with success in Nova Scotia, and from there went to Chicago, where he graduated at the College of Physicians and Surgeons. He then returned to Nova Scotia. This was about the year 1883. He stayed there until 1885, when he married his first wife, Miss Annie Brice Patterson, a young woman whose parents were respectable and quite prominent people. In 1885 he continued his studies in Edinburgh and took his wife with him. There he remained about a year and returned to America in 1887. He settled in New York City, where he began the practice of medicine, but, like most young practitioners, he met with the greatest difficulty. He was poor. He hadn't been in New York long when he obtained a divorce from his first wife. That was about November 12, 1890. About the same time he became acquainted with Mrs.

Anna B. Sutherland, who lived at No. 371 Halsey Street, Newark. She was fifteen or twenty years older than the defendant, and by economy and hard work in her line of business (she kept a house of ill-fame) had accumulated a considerable fortune. The defendant began to pay her successful attention. He boasted to his friends that this old woman had fallen in love with him. Before his marriage to her, November 29, 1890, he induced her to make a will in his behalf. It left him all her property. That will was drawn by a friend of Buchanan in Newark. He took two other friends over to Newark to witness its making. Two days later he married the woman. The couple came to New York and set up housekeeping at No. 267 West Eleventh Street. The house in Newark was rented; but the same furniture used at No. 371 Halsey Street was used in fitting up the house in New York. The life of the woman whom the defendant married was perfectly upright and beyond reproach during her married life. She was hard-working and industrious, attentive to business, and earnestly anxious for her husband's welfare. She died at No. 267 West Eleventh Street, on April 23, 1892, very suddenly.

"The defendant had been married but a short time to this woman when his friends began to hear rumors. To the majority of his friends in New York Dr. Buchanan said that he was not married; that the woman was his housekeeper. To but one person did he confess his marriage. After a time his friends began to hear of disagreements between him and his 'housekeeper.' He said, early in the middle of the year 1891, to one witness, 'I am getting tired of that old woman; I wish I had never married her. I wish I had never had anything to do with her at all.' Again, toward the latter part of 1891, he was heard to say, 'That old housekeeper of mine will drive me crazy. I am going to dump her. I am going to get rid of her.' Again, early in 1892, he told other friends that his housekeeper was continually quarrelling with him; that he was going to get rid of her without trouble; that she had given him money, but, nevertheless, he intended to break up his house and dispose of her in some way or another. Again, he said to a friend of his, in speaking of his wife, 'Her face is enough to drive a man crazy or to drink. Scandal or not, I am going to get rid of that old chromo.' Mrs. Buchanan had in the mean time planned a return to her old life, when, Buchanan, referring to this, said, 'Damn her, she shall never return to Halsey Street and open up her house there again. I'll fix her. She ruined my professional reputation. Imagine a man of my standing married to such a woman as that.' All this was early in April, 1892.

"Very soon after the union the defendant began running around with fresher and younger women. One was called Blanche, one Sadie, one Maggie, and one Hazel. Long before his second wife died, Dr. Buchanan made all his preparations to get rid of her and come into her money, and to do this so adroitly that he never would be found out. To forestall any possible suspicion, Buchanan went to some of his acquaintances and began throwing out hints that the 'old woman' had Bright's disease of the kid-

neys. To one he said, 'She can't live long. She is sure to die. She is sick now and can never get better.' Another expression he used was this, 'Go and see her once in a while, and keep her in good humor. She is sure to peg out in less than six months.' In order to prepare the way for certain other results which might follow upon his acts, he stated to one of his friends, 'That old woman threatens to poison herself if I insist upon breaking up.' Now, what do you suppose he told her? He said, 'I wish to God you would. You know where my poisons are kept. You could not please me better than by taking morphine. It would be the best thing for yourself and for me.' He saw to it that his mother, who had been living with him, was removed to another place. He sent his child by his first wife away. He was putting his house in order so that he might carry out his fell purposes. So one Friday morning, a year ago next month, Dr. Buchanan's wife was taken sick. A doctor was sent for. She was found to be in a highly nervous state, and she kept in that condition until two o'clock, when she was seen by Dr. McIntyre, who prescribed for her for hysterics. The dose which he prescribed was a small nervine, eight grains of chloral, with eight grains of bromide of sodium, a teaspoonful of which was to be taken every two hours, and he prescribed a two-ounce bottle, so that an ordinary person could have taken the whole bottle without danger. Dr. McIntyre, a reputable family physician of many years' standing, saw the patient in this excited, hypernervous state at two o'clock. At three o'clock Mrs. Childs, a nurse who had been called in, and Mrs. Brockway, wife of a dentist who was going to take the house from the Buchanans, happened to enter the sick woman's chamber, and they saw Dr. Buchanan giving his wife a dose of something with a spoon. And he attempted to follow it up with another after the first had been swallowed. Dr. Buchanan himself afterwards acknowledged that the medicine he gave his wife was that prescribed by Dr. McIntyre, who had advised but one teaspoonful of the medicine every two hours.

"Mrs. Brockway had sat down by the side of the bed and talked with the sick woman, and just after taking the dose from her husband's hand she reached out for an orange and tore a piece of it with her teeth to counteract the bitter taste in her mouth. The impression made upon the nurse at the time was that the medicine which had been taken by Mrs. Buchanan was bitter, whereas, the medicine prescribed by Dr. McIntyre at that time was not bitter, but slightly sweet. Immediately after taking that medicine given by the defendant—in about ten or fifteen minutes—the woman sank into a profound sleep. From sleep she went into stupor, and from stupor she went into a profound coma, from which she never awoke. Dr. Watson was called in. He asked Dr. Buchanan the history of the case. Dr. Buchanan said, 'She is suffering from kidney-trouble.' Dr. Watson at once came to the conclusion that the woman was suffering from coma produced by uræmic poisoning, and prescribed for her accordingly. He gave her a hypodermatic injection of digitalis, the antidote. In a few minutes Dr. McIntyre, the old

family physician, came in and made a diagnosis of the case. In order to assure themselves of the fact that the woman was suffering from uræmic poisoning, they drew urine and tested it with nitric acid. They found that the urine did not contain any albumen, and came to the conclusion that she was not suffering from uræmic poisoning. What is the next step? The doctors came to the conclusion that the woman, from some peculiarity of her constitution, was suffering from a coma produced by the chloral Dr. McIntyre had prescribed. They asked the defendant what he had given her, and, turning to Dr. McIntyre, he said he had given her 'one dose of your medicine.' Dr. McIntyre thereupon began to treat the patient as though she was suffering from coma produced by chloral; and he treated her thus for two hours by having her rubbed and irritated and using every means to bring her back to consciousness. At nine o'clock the doctors reassembled, having left at seven, and then Buchanan stepped up and said to them, 'Gentlemen, I want to disabuse your minds of the idea that this woman is suffering from chloral. Dr. Janeway has been prescribing much larger doses than that for her, and she has become used to it, and cannot be idiosyncratic to its influences.' Now, those doctors wavering, as all doctors must under the circumstances, not knowing with certainty from what the woman was suffering, were led by this defendant in the treatment of the patient. To their minds there were three things from which this woman could be suffering. She might have had from those symptoms either uræmia or coma produced by a narcotic, or she might have had coma produced by a third cause. Just as they were wavering in the balance, just as they were in doubt, what does Buchanan do? He said, 'Gentlemen, this woman's father died of cerebral apoplexy or cerebral hemorrhage.' That is also a disease of the brain, and presents almost similar symptoms to the other two things mentioned. In some cases like this it is impossible for any doctor to tell before an autopsy just what is the matter with the patient, the symptoms are so identical. When he stated that this woman's father died of cerebral apoplexy it turned the scales, and they came to the conclusion that the woman had cerebral hemorrhage, and prescribed accordingly. We find that the woman was treated first for kidney-disease on the statement of the defendant; second, that when she was treated for narcotism the defendant stepped in and prevented the continuance of the treatment, as we claim, for fear his labor might be lost; and, lastly, he impelled them to find in their diagnosis that she had cerebral hemorrhage by the statement that her father died of cerebral hemorrhage. Her father did not die of cerebral apoplexy. His death was caused by gangrene of the foot.

"After the death of Mrs. Buchanan, Dr. Buchanan acted most strangely. No funeral notice was published, except one insignificant notice in an afternoon paper. When asked by his friends why he had kept so reticent over his wife's death, his answer was, 'Why, I left all that to Benedict, the undertaker.' What was Benedict's answer when questioned? 'Buchanan said he would see to all that himself.' When asked why none of Mrs. Buchanan's

relatives were present, Buchanan said Mrs. Willard, her sister, was dead, and that her brother was dying in Philadelphia. The facts are that Mrs. Willard is alive, and the brother has not been heard from in years.

"Mrs. Buchanan died at three o'clock in the afternoon. What did Buchanan do? He visited the neighboring saloons, after saying he was going to Philadelphia to see his dying brother-in-law, and began to drink. To a friend whom he met he said, 'My God, I can't stay in the house with that dead body. I'm going to a hotel.' He got possession of the woman's jewels and displayed them to acquaintances. The funeral was held on the following Tuesday, April 26. Immediately after the funeral he is found in Newark going from one bad house to another. Between the woman's death and her burial he went to the Presbyterian minister, who preached the sermon over her, and told him that his wife was a pious Christian, and that when she was dying he thought that he heard her whisper the name of the Saviour.

"Twenty-one days after he buried his second wife he remarried his first wife in Halifax, Nova Scotia. In the marriage, in answer to the usual questions, he said that he was a bachelor. He comes back to New York and takes her, under the assumed name of Frazer, to the Hotel Hamilton, at One Hundred and Twenty-fifth Street and Eighth Avenue.

"Buchanan, when cognizant of the fact that people were asking curious questions relative to him, denied that he had remarried his first wife, and also said that his dead wife had never been mistress of an immoral house in Newark, nor had she been a morphine eater. These maladroit statements drew more attention to his case. After the newspapers began printing stories about the affair, the doctor went into hiding in Dostch's saloon up town, and disguised himself every day in a different make-up, with green goggles, etc. One night, when he suspected that a long story was to be printed the next day in a newspaper, he came down town and waited till it appeared in the early morning. If the story was printed he was to flee at once. Then there was the watching of his wife's grave. The moment the district attorney touched the mound he was to leave town and hide. A telegraph code was even arranged. Buchanan was to push West. If the matter blew over and the body was not dug up, a telegram was to be sent to him under an assumed name, to read in this way, 'Will ship goods immediately.' If the grave was turned, the despatch was to run, 'Can't ship goods,' and the doctor was to make haste and get farther out of the way.

"After consulting with Herbert W. Knight, his Newark lawyer, Buchanan wasn't satisfied. He was then advised to go and see one of the counsel in the Harris case. He went to see Charles E. Davidson, now one of his own lawyers. While going back to Newark, a friend said to him, 'Doctor, you are in no danger. The physicians have certified that she died of cerebral hemorrhage.' 'Ah,' he answered, 'but you know that symptoms vary and doctors frequently make mistakes.' 'Yes; but, doctor, you stated that this woman's eyes—the pupils of the eyes—were dilated, which

is inconsistent with the theory that she died of morphine.' 'Don't you know that drugs can be so compounded as to destroy the effects of morphine on the eye?' was his response. 'Don't you know that if you take belladonna its effect is to dilate the pupil of the eye and make it come back to its normal shape? I tell you that if they dig that woman up they will find her full of morphine, and morphine lasts in the body a great length of time.' Buchanan had previously told his lawyers that his wife was a morphine eater; but it is the first time that such an accusation was ever made against her.

"During the trial of the Harris case, Buchanan was greatly interested in it. Dr. Buchanan was a skilled compounder of drugs, a skilled physician. In canvassing the Harris case he said Harris was a —— young fool; that if he had known his business he would never have left any trace behind him."—*Extract from Assistant District Attorney Osborne's history of the case.*

Morphine and traces of atropine were found in the woman's body by the State's experts, and light was thrown upon all the facts of the symptoms attending the death of the woman. Furthermore, the defendant's wife was shown to have been poisoned by morphine, which was the cause of her death. The defendant was found guilty of murder in the first degree, and finally electrocuted. The case was tried before Recorder Smyth, New York City.

The hypothetical question framed by the prosecution was: "Suppose that a woman, healthy for her years and healthy the morning of her subsesequent illness, was attending to her usual household duties, ate a hearty breakfast, as though nothing—no sickness—was impending. Subsequently—a few hours—she was taken ill; was filled with great apprehension of a serious sickness; complained of a choking sensation, a constriction of the throat that made it difficult for her to breathe. Six hours later she was found in the same state, and at 3.30 P.M., after taking something, she sank into a deep sleep that became a coma, then a profound coma, from which she died; that in this coma the slowness of respiration, with the quickness of pulse, are out of proportion; that brisk external slapping aroused her from her coma, so that she opened her eyes; the examination, which showed no secretion of albuminoids, thus might indicate kidney-disease; the high temperature and flushed skin,—all these indicate narcotic poisoning of themselves, and the presence of them all together indicate two poisons, narcotic poisoning."

The Harris Case.—Carlyle W. Harris, a medical student at the College of Physicians and Surgeons, New York City, had in the summer of 1889 made the acquaintance of Mary Helen Neilson Potts at Ocean Grove, N. J., where her family were living.

"When they moved to the city of New York for the winter the acquaintance continued, and on February 8, 1890, obtaining permission from her mother to take her to see the Stock Exchange, he went with her before an alderman, and they were married under the assumed names of Charles

Harris and Helen Neilson. He was at the time pursuing his studies as a medical student in that city, and he continued to visit the deceased until her family returned, in May following, to Ocean Grove. He followed them there soon afterwards. Mrs. Potts, the mother of the deceased, testified that there was a falling off in his attentions to the deceased, and a marked change appeared in his manner toward her, which seemed to worry her. A young friend of the deceased, Miss Schofield, coming to visit her in June, upon the occasion of a walk, the defendant informed her, because, as he said, the deceased had insisted upon it, that they were secretly married. Upon Miss Schofield's saying that she would beg the deceased to tell her mother, the defendant became very angry and said she should not do so; that his prospects would be utterly ruined; and that he would rather kill her (the deceased) and himself than have the marriage made public, and expressed the wish that 'she' (the deceased) 'were dead and he were out of it.' Later in the day he went out with the deceased, was absent for several hours, and upon their return to the house she appeared pale and ill, and went directly to her room. Shortly after this, in the latter part of June, she went to Scranton, Pa., and visited an uncle, Dr. Treverton. While there Dr. Treverton discovered that she was with child, and treated her accordingly, but subsequently was obliged to remove from her a fœtus of five months' formation, which had been dead for some time. After the operation she recovered her health completely, and returned in the first part of September to Ocean Grove. While she was at Dr. Treverton's, and about the end of July, the defendant came, upon a telegram from the deceased and a letter from Dr. Treverton, and remained a few days. The operation for the removal of the fœtus was made while he was there. Dr. Treverton testified to conversations with the defendant upon the occasion of his visit, in which the defendant said he had performed two operations upon the deceased, and had thought everything was removed. He boasted of his previous intrigues with other women, and in his success in not having had any trouble before. Among other things, he said he had been 'secretly married to at least two other young ladies, and by one had a fine child.' During the same visit he had conversations with the witness Oliver, then visiting the Trevertons, in which he spoke boastingly of his experience with women, and of the facility with which he could gain sensual control of them. He said that in two instances he had overcome their scruples by a secret marriage ceremony, but was ready to stand by them. Upon witness asking him how he could stand by both, he answered, in substance, that there would be no trouble, as the first one was glad to get rid of him; and he went on to tell the circumstances of their relations, and of the final result that, after a child was born, the woman expressed her disgust with him and wanted to see no more of him. To neither Treverton nor Oliver does it appear that he admitted a contract of marriage with the deceased. While the deceased was at Treverton's her mother joined her, and then learned of the recent marriage and what had happened. In the first week of September the defendant was in the hotel

in Canandaigua, N. Y., under an assumed name, with a young woman named Drew. His conduct toward her was demonstrative in its affection, and her friends there, discovering their illicit relations, compelled him to leave. During his stay witness Latham overheard a conversation between him and the Drew woman, in which he advised her to marry some old gentleman with lots of money; and upon her asking, 'What if she did?' he is said to have replied, 'Oh, we can put him out of the way;' and upon her inquiring how, he further said, 'You find the old gentleman, and we will give him a pill, and I can fix him.' After the return of the deceased and her mother from Scranton, they met the defendant in New York City and lunched together. They talked about the secret marriage, of which the mother had been informed at Scranton. He offered to satisfy Mrs. Potts of its legality, and took her to the office of his lawyer, Mr. Davidson. The defendant told her he had burned the original marriage certificate, but sent for and obtained a copy from the records, and, upon Mr. Davidson's suggestion, attached it to an affidavit made by him, stating his marriage with the deceased under assumed names before an alderman. During a conversation at the office he asked if Mr. Potts knew of the marriage. Mrs. Potts said it was no time to tell him then, and asked him if he had told his mother. He said, 'No; he would not have his family know of it for half a million dollars.' He suggested to Mrs. Potts that if she was unhappy about the marriage it could easily be broken, and no one would be the wiser. Upon her expressing herself in indignant refusal of the suggestion and insisting upon a 'ministerial' marriage, he objected to it at the time, alleging as an excuse that it would connect her name with certain club scandals in which he was involved at Asbury Park. He promised, however, to have the ministerial marriage at any time in the future that Mrs. Potts should say. He expressed his gratification at her not pushing the matter of marriage at that time; that if she had he would have been obliged to 'leave everything and go West.'

"Upon that occasion he suggested putting the deceased at Miss Comstock's school, to fit her, as he said, for the society in which they were to move, to which suggestion Mrs. Potts acceded. At his request she promised to write to Dr. Treverton and express her satisfaction with the marriage, and to prevent the doctor from making any trouble for him at the medical college, as he had all he could do, he said, to meet the charge of keeping a disorderly house. Upon leaving the lawyer's office they joined the deceased at the ferry, he crossing with them. The deceased learned of her mother's being satisfied about the marriage, and she seemed to be made very happy in consequence.

"In December the deceased was placed at school, and, as a friend of the family, the defendant received permission to visit her. During her visit to her home in the holidays he wrote the deceased, asking that no announcement should be made of their engagement at this time. In reply to a letter from Mrs. Potts, in the first week of January, he wrote suggesting that there should be no further question of marriage for two years longer, and

that her daughter should take a collegiate course. About January 18 or 19, Mrs. Potts wrote to the defendant, expressing herself strongly upon the hardship of her daughter's position, with a delay of three years as an unacknowledged wife, and for no apparent reason; that her daughter's illness at Scranton had been commented upon; that if he should die it would be humiliating to publish a marriage under the circumstances of its contracting; that her husband might meet Dr. Treverton and be told of the illness at Scranton and of the doctor's doubts about a marriage. She concluded by asking him to keep his word and to do as he had promised her, and demanded of him to go upon the anniversary of the first marriage, February , and be married before a minister of the gospel, and give her the certificate hold, which she would make public at such time as she chose. To this e replied that he would do all she asked of him, if no other means of tisfying her scruples could be found. On Tuesday, January 20, a day ter he received Mrs. Potts's letter, the defendant went to the shop of [cIntyre & Sons, druggists, in New York City, and at first ordered some psules of sandal-wood to be put up. Upon the clerk mentioning that it ould take some time, he said he could not wait. He then handed the erk a prescription, asking if it would take long to prepare, and, upon arning that it would take a few minutes, waited for it. It called for twenty-ve grains of quinine and one grain of sulphate of morphine, mixed in six apsules, with the direction to take one before retiring. The prescription as put up by the clerk with minute care, he being aided by another clerk, ho checked the amount and weight of the morphine, according to a custom dopted where poisons are put up. The box, properly labelled, containing ix capsules, each capsule containing one-sixth of a grain of morphine and our grains and a fraction of quinine, was taken by Harris. He never called or the sandal-wood capsules. The following day, being Wednesday, January 21, he was at the school reception and saw the deceased.

"The testimony in the case shows that the defendant stated to both oroner and deputy coroner, when shown and asked about the pill-box aken from the room of the deceased, that it was the one that he had given to er on Wednesday, January 21, and he described the prescription as above, tating that he had given it to her for headaches, and that he had given her nly four of the capsules. It was also shown by the testimony of several vitnesses from the medical college that in the latter part of December and he first part of January lectures were given upon opium and its effects when ised feloniously. The sulphate of morphine, contained in wide-mouthed ottles, had been passed around among the students, of whom the defendant vas one, and they were allowed to take it out and to handle it when they hose.

"After meeting the deceased at the reception on Wednesday, January 1, the defendant left for Old Point Comfort, Va., and did not return until a veek later. While there it appears that the deceased wrote to him that the nedicine had not relieved headache, but rather made it worse; to which he

replied, advising her to continue taking it. On January 31 the deceased, her mother, and the defendant met at the school and walked together. The deceased seemed perfectly well, and very bright and happy. Mother and daughter returned to the school, and when in the bedroom of the deceased she showed her mother the pill-box, with one capsule left in it, and remarked that she had been taking some capsules that Carl (the defendant) had brought her. She complained of their making her feel ill, and of her dislike to take them. She said she was tempted to toss it out of the window, and then to tell Miss Day, the principal, that she had taken it. Her mother advised her to take it, remarking that quinine was apt to make one feel wretched, and that she might have been malarious. Her mother left, and then occurred the scenes of illness and death of that night. The defendant was sent for toward daylight by Dr. Fowler, who, stating that he believed it to be a case of pronounced opium-poisoning, wished to learn what had been contained in the pill-box in her room, and which not only was the only evidence of anything like medicine about the room, but which, according to her room-mates, was the only medicine in the room that day. The defendant told him what had been its contents, and of his having prescribed the capsules for headache, insomnia, and the like. Dr. Fowler said one-sixth of a grain could not produce the condition, and advised him to go at once to the druggist and ascertain if the proportions of the drugs had been reversed. He pretended to go immediately, and, when he shortly after returned, stated to Dr. Fowler that the medicines had been prepared exactly according to his prescription. The evidence shows that he did not go to the druggist's that morning, as supposed by Dr. Fowler, nor until eleven o'clock, and after the death, when Dr. Kerr told him to go and try and get the original prescription, if he could. During the time he was in the room where the deceased lay he surprised the physicians by his composure and general lack of interest or affection, except when, upon her death-bed, he exclaimed, 'My God! what will become of me?' He spoke to the physicians of being 'somewhat interested in the girl,' and mentioned a possible future engagement to her. He asked them repeatedly if they thought he could be held responsible for the death. To them and to the coroner he said that he was merely a friend to the deceased, and pretended hesitation as to her correct given name.

"On the evening of the Sunday he met Mrs. Potts at the ferry-house and stated to her that her daughter had died of morphine-poisoning, and represented it as 'the druggist's awful mistake.' Mrs. Potts says that when she told him that, as the deceased was the mother of his child, she must be buried under his name, his terror was frightful, and he said it could not be; that he would do anything, but that the knowledge of the marriage coming at this time would destroy him; that he would answer just the same if it was Queen Victoria's daughter, 'She cannot be buried under my name,' and he urged as a pretext consideration for the school.

"The coroner met him at the school in the evening. The defendant

said he had one of the capsules prescribed for the deceased, and gave it to the coroner, telling him to analyze it and it would be found all right. Subsequent chemical analysis of it proved the correctness in preparing the prescription. The mother, in order, as she says, to get a permit to take the body as soon as possible out of the house and to New Jersey, represented falsely, as she also admitted, that her daughter had heart-trouble. She left the next day with the body. Some days later the defendant stated to Dr. Hayden, in conversation about the occurrence, and when rebuked for writing prescriptions, that 'These capsules would not hurt any one, and no jury would convict me, because I have two capsules which can be analyzed and be found to contain the correct dose.'

"Of the druggist's clerk, witness Powers, at the interview at the store on February 7, when obtaining some medicine, he asked if he had seen the account of the death in the papers, and whether he believed it; and upon the witness expressing his belief that the girl died of heart-disease, said, 'So do I.' They talked about the putting up of the prescription, and the defendant said there was no doubt that it was all right. To Dr. Peabody, whom he went to see with an introductory letter from his medical preceptor, a day or two after the death, to whom he stated the circumstances attending it, he described the prescription and for what given, and alleged as an excuse for keeping out two of the capsules that it was injudicious to put as much as a grain of morphine in a girls' school. Later in February, in a conversation with Dr. White, he said he did not know whether the druggist had made a mistake, or whether there was a brain tumor, which would account for the fact that the morphine in the capsules had been the cause of death. A few days before the coroner's inquest, which was held on February 27, the defendant met Mrs. Potts and said that the coroner's inquest would exonerate him, and that he was innocent; and upon her remarking, 'If innocent, how did she die?' he replied that 'It was the druggist's mistake.' She asked how that could be, when he had said the capsules, upon being analyzed, would prove it to be all right, and said the statements conflicted. He ascertained from her that neither Mr. Potts nor Dr. Treverton knew of her fears. He then endeavored to obtain from her the affidavit of the marriage, saying that he must have it; that it was more valuable than he dare tell her. She said she would not give it. 'It is not here.'"

The body of the deceased was exhumed, and morphine was discovered in the girl's stomach and intestines. The defendant was found guilty of murder in the first degree, and electrocuted. The case was tried before Recorder Smyth, New York City, January, 1892.

Digitalin-Poisoning.—*The De la Pomerais Case.*—This is probably the only instance of homicidal poisoning by digitalin. De la Pomerais, a homœopathic physician of France, after having had his former mistress's life insured in various companies for his own benefit, fatally poisoned her. He was tried and found guilty of the indictment. Following one of the defendant's visits to his victim, she died, after suffering from violent vomiting

and great depression of the action of the heart and debility, within twent four hours. Thirteen days after her demise her body was disinterred, tl actions of the defendant having been of such a nature as to create suspicic and associate him with the crime. Chemical research having failed to di cover any poison, the medical examiners, Tardieu and Roussin, resorted the physiologic or frog test, employing some of the extract obtained fro the stomach and bowels of the woman, and also one procured from tl scrapings of the floor on which the dead person had vomited. These tes responded to all the known chemical reactions. Besides the eviden furnished by the tests, an unusually large amount of digitalin was four in the possession of the accused, forming strong circumstantial evidence his guilt. The prisoner was executed. (*Vide* Reese, "Medical Jurispr dence," p. 457.)

Nicotine-Poisoning.—*The Count Bocarmé Case.*—Reese describes tl celebrated case as follows. Count Bocarmé was executed in Belgium, 185 for poisoning his brother-in-law, Gustave Fougnies, with nicotine. "A unknown quantity was forcibly put into the mouth of the victim, the counte assisting her husband as an accomplice in the murder. Death was believ to have taken place within five minutes. The poison was detected by M Stäs in the tongue, throat, stomach, liver, and spleen of the deceased, ar also from stains on the floor near where the act was committed. From tl excellent report of the examination of M. Stäs we may note the followir particulars. The appearance of the tongue indicated the action of son highly acrid agent; it was swollen, blackened, softened, and friable; tl epithelium was easily detached. This was also the condition of the mucou lining of the mouth and pharynx; it was reddened as if cauterized, ar easily separated. The lining membrane of the stomach was intensely ir jected, exhibiting large patches, which were livid and black. The vesse were filled with a black coagulum, resembling blood that had been treate with sulphuric acid. The duodenum was also highly injected. There we no ulcerations or perforations of the stomach or bowels. The lungs we engorged with black blood, and exhibited the usual character of asphyxi The heart was normal, its cavities containing black liquid blood. No od was observed in the body." ("Medical Jurisprudence.")

The Holmes-Pitezel Case.—The crime for which Herman W. Mudget *alias* H. H. Holmes, was executed at Philadelphia, Pa., May 7, 1896, wa the murder on Sunday, September 3, 1894, of Benjamin F. Pitezel, a co federate, at Philadelphia. The history of the crime, briefly, is as follow "Eugene Smith, a house-carpenter, while passing along Callowhill Stree between Thirteenth and Broad, was attracted by a sign in the house nun bered 1316. The sign consisted of a sheet of muslin stretched across tl bulk window, on which was printed, in black and red letters, 'Patents bougl and sold. B. F. Perry.' Now, it happened that Smith himself was an ir ventor. He had recently obtained what he claimed to be a valuable paten He determined to step in and consult Mr. Perry. Walking into the stor

he was greeted by a tall, raw-boned, sharp-featured man, who said he was Perry. There was some talk over the purchase of the patent, which was continued at a second visit, but nothing definite was arrived at. On the second visit, however, Smith was employed by Perry to put up a rough counter, required for business purposes, in the first-floor store-room of the house. It was while working at this counter that Smith saw a man enter, give a sign to Perry, and pass upstairs to the second story. Perry followed the stranger, and remained with him for half an hour. In that stranger Smith afterwards recognized H. H. Holmes. The counter was finished, and for some days Smith had no occasion to see Perry again; but on September 3 he called to ascertain whether anything had been done about the patent. He opened the door. The store within was vacant. Smith hallooed at the top of his voice, but there was no answer. He waited for half an hour, and then left. Early next morning he returned. He found the door shut, but not bolted, just as he had left it. On entering there was the same silence and vacancy. But this time Smith's suspicions were aroused. He made his way upstairs. There was no one in the front room; but when he turned and entered the back room he met a sight that chilled his blood. Lying prostrate on the floor was a corpse. It was dressed in the clothes that Perry had worn. It was the proportions of Perry; but the face was disfigured beyond recognition, caused by decomposition and burning. At the side of the body lay the fragments of a large broken bottle, a pipe filled with tobacco, and a burned match. Smith gave the alarm to the police. The body was removed to the city morgue. The coroner's inquest followed, and a verdict of death from congestion of the lungs, caused by inhalation of flame, or of chloroform, or other poisonous drug, was given; but whether it was murder, suicide, or accident neither the jury nor any one else could determine. Eleven days passed. Then B. F. Perry's body was buried in the Potter's Field. Even before the burial two letters had been received in Philadelphia, one by the coroner, the other by the Fidelity Life Insurance Company. Both came from Jephtha D. Howe, a St. Louis lawyer. He wrote as the representative of Carrie A., wife of Benjamin F. Pitezel. The latter was insured in the Fidelity Company for ten thousand dollars. Howe wrote that B. F. Perry was an *alias* assumed by B. F. Pitezel, and announced that he was coming on to Philadelphia with a member of the Pitezel family to identify the body and claim the insurance. It was found that the policy on Pitezel's life had been issued on November 9, 1893, at the branch office in Chicago. From Chicago it was ascertained that Pitezel's most intimate acquaintance was one H. H. Holmes, who lived at Wilmette, Ill. After some correspondence with Holmes, the latter consented to come on to Philadelphia and examine the body.

"Holmes and Howe met in the office of the Fidelity Company. They were introduced as strangers and shook hands. But Holmes recognized Alice Pitezel, the fifteen-year-old girl who had accompanied the St. Louis lawyer, and she him. All the performers in this little farce went through

their parts with sufficient skill to impose upon the Philadelphia insurance men.

"The marks of identification—a wart on the neck, a cut on the leg, and a bruised nail of the thumb, together with certain peculiarities of the teeth—were then agreed upon. The body was disinterred, and all the marks were found upon it. The officers of the company decided that the identification was complete. A check for the amount of the policy, less the attendant expenses, was handed over to Mr. Howe. Everybody seemed satisfied. The matter was soon forgotten in the multiplicity of duties incident to the business of a great insurance company. But the attention of the officers was recalled to the case by a letter from one Marian C. Hedgepeth, an inmate of the St. Louis City Prison. The writer claimed to be acquainted with both Howe and Holmes. He had introduced them, in fact, and he was to have received five hundred dollars as his share in a conspiracy into which they had entered to defraud the insurance company. And this was the plan as Hedgepeth detailed it. Pitezel had already been insured. Holmes was to make Pitezel fix himself up and appear that he was mortally wounded by an explosion, and then put a corpse in place of Pitezel's body, etc., and then have it identified as that of Pitezel. But, according to Howe, it was almost positive that Holmes deceived Pitezel, and that Pitezel, in following out Holmes's instructions, was killed. The writer naïvely concluded, 'It is hardly worth while to say that I never got the five hundred dollars that Holmes held out to me to introduce him to Mr. Howe.'

"Strange to say, the company was inclined to treat this letter as the fake of a wily criminal. Not so the Philadelphia police. The aid of the Pinkerton detectives was called in. Holmes was traced from place to place, his real name and his identity were discovered, and on November 17, 1894, he was arrested in Boston. . . . After having murdered his victim, Holmes set about to divert suspicion by burning portions of Pitezel's body, but the fire did not destroy his life. While the broken jar and other evidences of the explosion were present, it was clearly shown that they were artificially produced by some person with the intent to mislead. There was no explosion, for, according to the medical examiner, who visited the scene of the tragedy as soon as Pitezel's body was discovered, the pieces of the broken jar were inside the jar itself. The medical examiners explained to the jury the post-mortem appearances of the body, the condition of the heart, and the congested state of the lungs, showing conclusively that the death was sudden. They testified that the deceased died from *chloroform-poisoning*. The condition of the stomach, intestines, and liver indicated that the man had been addicted to the drinking habit, in fact, was a heavy indulger. But the condition of the stomach was from chloroform. The physicians found about two ounces of the poison in the stomach, and the odor was very strong.

"The plea advanced by the defence—that of suicide—was refuted by the evidence presented by the prosecution. All the surroundings of the case

deny suicide. . . . Numerous other crimes are laid at Holmes's door, and he has been pictured as the worst fiend of modern times."

OTHER CASES.

Identification of Mutilated Remains.—*The Parkman-Webster Case.*—"Dr. Parkman was murdered by Dr. Webster in Boston, Mass., about thirty years ago. After the death of his victim, Dr. Webster attempted to destroy all evidences of the deed by cutting up the body into fragments, some of which were burned in a grate, some immersed in chemicals, and others packed away in boxes in distant parts of the building. On the discovery of these remains, a week after the murder, the portions of the body were accurately examined by a skilled anatomist. It was proved that they were human remains, belonging to one and the same body, of the male sex, and that they had not been dissected for anatomical purposes, but cut and hacked in different directions, with the object, evidently, of mutilation. On restoring these disjointed parts *in situ*, and supplying the deficient portions, it was found that the proper measurements agreed closely with those of the missing Dr. Parkman. This circumstance, together with the discovery of certain marks of identity about the teeth and jaws (the head had been almost completely destroyed by fire), afforded sufficient evidence to enable the jury, on the trial of Dr. Webster, to find a verdict of guilty." (Reese, "Medical Jurisprudence.")

Wounds before and after Death.—Casper reports a case where the victim's head was severed from his body, and, as the head was completely drained of blood, the conclusion was reached that the decapitation had been done during the life of the deceased, and that there must then have occurred a profuse hemorrhage to account for the want of blood after death. (Reese.)

Cadaveric Rigidity.—"The ice broke while a young man was skating. For a time he supported himself by resting with both elbows on the sound ice surrounding the broken portion, the lower part of his body at this time only being submerged. Eventually the ice on which he rested gave way, and he fell into the water and was drowned. The following day the body was recovered. The arms were found bent, and in the precise position in which he had rested on the ice the previous day. The position of his legs further indicated that he had exerted himself powerfully during the last moments of his life to keep his head above water." (Quoted by Tidy, *op. cit.*)

Personal Identity.—"The body of an old man was found on the bank of the Dee, at Drumoak. The left ear and the first finger of the left hand were wanting, the mutilation apparently of long standing. Two young women claimed the body as that of their father, who had been in the habit of leaving home for weeks at a time, and who had lost his left ear and left forefinger. On the return of the daughters and friends of the supposed party from his funeral, the boatman of a ferry which they had to cross asked them for whom they were in mourning, and, on receiving their answer,

laughingly informed them that he had only half an hour before ferried their father over, alive and well, which, on reaching home, they found to be true. Whose the body was which they had interred was not discovered." (Quoted by Tidy.)

The writer is familiar with many cases of doubtful identification. In the Meyer case he testified that, while coroner's physician, he was summoned to see a body. Death had evidently been caused by cerebral hemorrhage. While there three women called, each with a photograph, and each identified the corpse as that of her husband. The body was in a good state of preservation, and had been dead only three-quarters of an hour. In another instance a woman identified a body as that of her husband, and when she returned to her home she found her husband in bed, sound asleep. In another case a body which had been buried three months was identified as that of a person who turned out to be alive and well; and in yet another instance the body of a boy, sixteen years of age, was positively identified by a woman as that of her son, while the father disclaimed it. It was the body of a boy who had been killed in a railway accident, and after the dispute of the parents as to its identity it was removed to the city morgue. The writer has seen a body identified by nineteen people, who all claimed it.

The Lane Case (Whitechapel Tragedy).—"In November, 1875, Henry Wainwright was tried and found guilty of the murder of Harriet Lane, a woman with whom he cohabited. Two bullets were found in the brain and a third among the hair, flattened by forcible contact with the skull, proving that she had been shot; but in addition it was also evident that her throat had been cut, one carotid artery having been severed. The crime was discovered by a workman, who noticed a mutilated hand protruding from a badly smelling bundle, wrapped in American cloth. The prisoner was removing this and another bundle in a cab, and was smoking to hide the odor. A *danseuse* of his acquaintance was in the cab with him. When a policeman could be found to stop the cab it was discovered that one parcel contained the decomposed trunk of an adult female body. The contents of the second bundle disclosed the head of a female so covered with lime (and chlorinated lime) that it was difficult to guess her age. The arms and legs were also in the parcel. In the Whitechapel premises a new spade, soiled with lime, etc., and a grave under the floor containing disinfectants, were discovered. The poor woman had disappeared nearly twelve months previously (September, 1874). She had had two children. The body was identified by some jewelry found on the premises. It was partly mummified and partly converted into adipocere, and had been cut into ten different portions. It was very roughly dismembered, so that a part of the pelvis was connected with the thighs. The medical witnesses supposed her to be about twenty-five years of age and five feet high. There were two distinct fractures of the skull, due to the two bullets. Mr. Larkin, the medical witness first called, said that one of the bullets had entered during life. This he judged from the extravasation of blood underneath the scalp for a considerable dis-

tance around the wound. There was also extravasation *within* the skull, following the direction of the bullet. A *scar* was noticed on the right leg. 'It was an elongated scar, as big as a shilling, but the puckering or drawn skin was much bigger. It was such a scar as a burn, say from a red-hot poker, would produce.' He also deposed that, owing to the extravasation of blood in or about the parts, the throat must have been cut either just before or immediately after death. The bullets were flattened, but had been conoidal. One weighed sixty-six grains, one seventy-eight, and the third seventy-two grains. The hairs on the shovel were proved by Mr. Bond to correspond with those of the deceased. 'The throat-wounds were either homicidal or had been inflicted suicidally by a left-handed person.' Mr. Larkin gave it as his opinion that the deceased had had children, partly from the *lineæ albicantes*, and partly from the appearance of the uterus." (Quoted by Tidy.)

Burns and Scalds.—"A pretty citizeness of London had had six husbands, one after the other, the first to please her parents, the rest to please herself. One of her countrymen was brave enough to allow her to make him her seventh husband. For a few months all went merrily. Her fondness, perhaps, made her indiscreet. She told her husband all the faults and follies of his predecessors. She disliked some because they were sots, others because they were unfaithful to her. In short, she had no good words for any of them. The husband, suspecting something, and wishing to test the character of his wife, began to stay out late, and to appear drunk when he returned. She first reproached him, then began to threaten; but he continued to stop out late, and to feign drunkenness, even more often than before. One night, when she believed him dead drunk and fast asleep, she took a lead button from the sleeve of her dress, melted it in a pipe, and approached the pretended sleeper to pour the melted metal into his ear. The husband, no longer doubting her guilt, seized her, cried for help, and gave her up to justice. She was first imprisoned, and then tried, the dead bodies of her six husbands being exhumed, and all bearing witness against her by the discovery of lead in their ears and brains. On this evidence she was condemned to death. Hence the origin of coroners' inquests in England." (Quoted by Tidy.)

The Halke Case.—Murder of Widow Halke, aged seventy, by Fritz. "The woman had been subjected to violence, and the body afterwards burned. The question was, Did the woman die from the violence (of which the prisoner was undoubtedly guilty) or from the effects of the fire (of which the prisoner might have been innocent)? Vesications were found on the body, some of which contained serum, others being empty. The post-mortem showed clearly that asphyxia was the cause of death. The question then arose, Was the asphyxia the result of strangulation (which the prisoner denied) or the effect of fire? A stoppage to respiration might have resulted from an injury to the nose that the victim had sustained, and to the circumstance that after the prisoner had stunned the woman, he turned her face to

the floor. Although the fire was so severe that the whole of the clothes were consumed and the body carbonized, yet Casper (who reported the case) thought the fire was insufficient, supposing the woman to have been alive, to cause the asphyxia." (Quoted by Tidy.)

A female child, aged six years, was scalded with a pot of boiling coffee overturned upon the side of the neck, right axilla, thorax, and right arm. Death in eight days. The post-mortem examination showed brownish patches and granulating sores, pleurisy of the right side, pericardial effusion, body anæmic.[1]

The Druse Case.—"Mrs. Druse, with the compulsory aid of her children, killed her husband with an axe. The body was burned in a wood-stove, with pine shingles. The ashes were thrown into a swamp near by. They were found and carefully sifted. Pieces of bone of various sizes, identified as human, were found, as also a few porcelain buttons, etc. A few hairs found with stains completed the identity. Experiments in this case showed that the body could have been consumed within *ten* hours. The prisoner was convicted of murder." (Quoted by Stoddard, *op. cit.*)

Heat and Cold.—*Sunstroke.*—A boy, sixteen years of age, was suddenly seized with sunstroke while harvesting. Insensibility, convulsions with clinched teeth, conjunctivæ congested, and pupils in a state of contraction. Venesection was performed, with an abatement of the symptoms.[2]

Tidy quotes the case of a female, aged fifty-five years, who was found on the ice, dead and stiff. Post-mortem: "No signs of injuries, except abrasions on the knuckles, probably due to her having had a fit and throwing her arms about. Brain appeared half frozen, the cerebral veins and sinuses being only moderately full; lungs normal; trachea pale and empty; right side of the heart fairly full of blood and the left side distended; blood natural; liver moderately congested; kidneys and spleen normal; ascending vena cava congested. Opinion: Death the result of cardiac apoplexy, possibly from the effects of cold, but more likely from a convulsive attack while walking over the ice." (Casper.)

Infanticide.—*Vide* the following cases: Beale's, *Lancet*, July 11, 1846; Ruge's, *British Medical Journal*, April 6, 1878, p. 490; Casper's various cases, "Forensic Medicine;" Tardieu's various cases; Stanelli's case, *Gazette des Hôpitaux*, November 7, 1846, p. 523, etc.[3]

MISCELLANEOUS MATTERS.

The Stomach Test in Murder Trials.—In the *Boston Medical and Surgical Journal* of February 28, 1895, Dr. Gustav Liebmann contributes a

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[1] Casper, Forensic Medicine.

[2] Medical Times and Gazette, August 27, 1870.

[3] For other important cases associated with the various subjects of this work the reader is referred to the larger books on Medical Jurisprudence.

short paper on this subject. He stated that the object of this test is to ascertain, by the presence or absence of solid contents, or by the intermediary stages of liquefaction of food found in the stomach, how far the process of digestion has advanced, giving thus a clue as to the time at which the death of the victim has taken place, provided the time of the last meal be known. In order to arrive at an exact conclusion, the first and imperative condition would be a uniformly established schedule of time in which the different phases of digestion should be completed. If there be such a physiological law from which there is practically no deviation, we should place full reliance upon the test; but if there be, in healthy people even, numerous exceptions or deviations, the test must of necessity be open to errors. Dr. Liebmann considers that this latter proposition is the true one. The different variations in the duration of the digestive process depend upon the following conditions. 1. The length of time necessary for the transformation of solids into chyme in healthy individuals varies a great deal according to the digestibility of the different foods. 2. The length of time necessary to expel the ingesta from the stomach into the duodenum in the healthy individual varies according to the quantities of food taken. Not only does it take a longer time for larger quantities to be impelled on, but the motor activity of the stomach walls is diminished by the greater distention produced by the larger amount of food present. Thus, pieces of meat are frequently found a day or longer after ingestion. 3. The shorter or longer stay of food depends on the amount of acidity, which varies in different stomachs, even within the border-line of health. 4. Much variation, even in health, is caused by individuality, by presence or absence of pepsin, hydrochloric acid, psychical factors and emotions (fear, grief, or the opposite, as joy or exaltation). We see therefore that, owing to the many physical variations, even in the healthy, the forensic value of this test must be considerably impaired. (*Times and Register*, Philadelphia, June 15, 1895.)

Legal Status of the Dead Body.[1]—*Alabama.*—Removal of body wantonly for dissection or sale, purchase of a body unlawfully disinterred, violating grave with intent to steal body, etc., or wantonly mutilating body, is punishable by fine or imprisonment (Code, secs. 4023, 4028). Coroner or, in his absence, justice of the peace to hold inquest and direct examination of body by surgeon, etc. (Code, sec. 4801 *et seq.*).

Arizona.—Mutilation, etc., of dead body is a felony (Penal Code, sec. 491). Removal of a part of body unlawfully is punishable (Penal Code, sec. 492). Duty of burying body is, if a married woman, on husband; if not a married woman, on nearest of kin who is an adult possessed of sufficient means. If deceased has no relatives, on coroner holding inquest or overseers, etc., of poor (Penal Code, sec. 493). Refusal of one on whom duty of burial is imposed by law is punishable (Penal Code, sec. 494). Arrest or

[1] Taken from Becker's contribution to Witthaus's Medical Jurisprudence, Forensic Medicine, and Toxicology, vol. i. p. 309.

stranger or traveller who died unknown (Mill's Stat., secs. 1547, 1548). Non-resident poor person to be decently buried (Mill's Stat., sec. 3391). Coroner to hold inquest, etc., or, if none, bury it decently at expense of county (Mill's Stat., secs. 870–882). Removal of body unlawfully for sale, dissection, etc., punishable (Mill's Stat., sec. 1367). Board of health may direct removal of dead bodies from cemetery within a city (Laws, 1893, ch. 113, sec. 54).

Connecticut.—No body shall be buried or disinterred or removed beyond limits of any town unless a permit is obtained, and, where deceased died of an infectious disease, body shall be in a hermetically sealed case (Gen. Stat., secs. 106, 108, 113). Custody of remains is in husband or wife or next of kin (Gen. Stat., sec. 536). Coroner to hold inquest, etc. (Gen. Stat., secs. 2005, 2008). And deliver body to friends, or, if none, to town authorities for burial (Gen. Stat., sec. 2015). Mayor, etc., may deliver bodies of those not buried within twenty-four hours after death to medical college for dissection, etc., unless relatives or friends do not consent, or deceased requested to be buried, or was a stranger or traveller (Gen. Stat., sec. 1729). Bodies of convicts dying in State prison, and not having any known relatives, shall be delivered to medical institution of Yale College (Gen. Stat., sec. 1732). Body of one dying in a hospital shall not be examined unless father, etc., consent, or, if none, within forty-eight hours after death (Gen. Stat., sec. 1735). Removal of body from grave unlawfully, or receiving, secreting, or dissecting same, is punishable (Gen. Stat., 1880). Body of executed criminal shall be buried by sheriff (Gen. Stat., sec. 1640).

Delaware.—Coroner to hold inquest, etc., or may cause body to be disinterred (R. L., ch. 33). Removal of body from grave unlawfully a misdemeanor (Laws, ch. 204, 1883).

Florida.—Buying, selling, or having in possession for purpose of buying or selling, a dead body is punishable (R. L., sec. 2625). Concealing birth of issue which, if born alive, would be a bastard is punishable (R. L., sec. 2393). Coroner to hold inquest, etc. (R. L., secs. 3011, 3019).

Georgia.—Coroner to hold inquest or to disinter same for inquisition (Code, secs. 410, 590, 591, *et seq.*). Public officers and their assistants, and their deputies of every county, city, town, or other municipality, or of every prison, chain-gang, penitentiary, county morgue, public hospital, having control of dead body to be buried at public expense (not dying of infectious disease), shall deliver same to medical college for dissection, etc., unless claimed by friends or relatives, or such friends or relatives request same to be buried, or unless deceased was a stranger or traveller (Laws, 1887, vol. ii. p. 77). Removal of body from grave, etc., unlawfully for dissection or sale is felony; or receiving or purchasing it, knowing it to have been so taken, or trafficking in dead bodies, or having them conveyed without the State for sale, etc., is a felony (Laws, 1882, vol. ii. p. 87).

Idaho.—Coroner to hold inquest, etc., and may exhume it for that purpose (R. L., sec. 8377). Coroner to bury body decently when not claimed

by relatives, etc., and, if necessary, at expense of county (R. L., sec. 2081).

Illinois.—Removal of body unlawfully or aiding in such removal is punishable as a felony, one to ten years (S. & C. Am. Stat., vol. i. p. 794). Coroner to hold inquest, etc. (S. & C. Am. Stat., vol. i. p. 606). And to deliver body to friends, or bury decently if no friends claim it, if necessary at county expense (S. & C. Am. Stat., vol. i. p. 606). Body of executed criminals may be delivered to any physician or surgeon for dissection, unless friends object (S. & C. Am. Stat., vol. i. p. 869; Crim. Code, sec. 503). In cities and counties, where population exceeds one hundred thousand, superintendents of penitentiaries, wardens of poor-houses, coroner, city undertaker, having body required to be buried at public expense, may deliver remains to medical college or any physician or surgeon for dissection, unless claimed by relatives (S. & C. Am. Stat., vol. iii. p. 867).

Indiana.—Removal of dead body or part of same unlawfully is a felony (R. L., sec. 2165). Concealment of body or part thereof, which has been unlawfully used for dissection, is a felony (R. L., sec. 2167). Receiving or buying a body, knowing it to have been unlawfully disinterred, is a felony (R. L., sec. 2168). Dead body of one dying in a State, city, or county prison or jail, or county asylum or infirmary or public hospital, or dead body of an executed criminal, or dead body of a vagrant, or one killed while committing a felony or escaping from prison or officers, may be delivered to the faculty of a medical college in State for dissection, etc., unless deceased requested to be buried, or body is claimed by next of kin (R. L., sec. 4258 *et seq.*). Dissecting or possessing body for dissection, except as prescribed by law, is a felony (R. L., sec. 4271). Coroner to hold inquest, etc. (R. L., secs. 5878, 5879).

Iowa.—Coroner to hold inquest, etc. (McCl. Am. Code, sec. 487). To bury body decently at expense of county, if necessary, or deliver it to relatives (McCl. Am. Code, sec. 501). Removal, etc., of dead body unlawfully, or aiding such removal, or knowingly receiving body so removed, etc., is punishable (McCl. Am. Code, sec. 5328). Coroner, undertaker, superintendent of public asylum, hospital, poor-house, or penitentiary may deliver body to medical college or physician for dissection, etc., unless relatives, etc., refuse, or deceased desired to be buried (McCl. Am. Code, sec. 5329). Bodies of those executed, or dying in hospitals or prisons under sentence for crime, shall be delivered to medical college or association, or physician or surgeon, for dissection, etc., unless relatives or friends do not consent, or deceased expressed a wish to be buried, and after such use the remains shall be interred (Gen. Stat., sec. 3758). State board of health shall issue permits for transportation of bodies beyond county where death occurred (Gen. Stat., sec. 6030).

Kansas.—Coroner to hold inquest, etc. (Gen. Stat., secs. 1780, 15,794). To bury body if not claimed by friends, etc., and at public expense if necessary (Gen. Stat., sec. 1792). Removal of a body unlawfully for dissection or

wantonly, or receiving body, knowing it to have been so removed, is a misdemeanor (Gen. Stat., sec. 2372 *et seq.*).

Kentucky.—Coroner to hold inquest, etc. (Gen. Stat., ch. 25, secs. 3, 11). To bury the body or deliver to friends (Gen. Stat., ch. 25, sec. 6). Body of one dying on a steamboat or other craft, if not claimed by friends, shall be buried by master or officer in command on shore, at least four feet deep (Gen. Stat., ch. 29, art. 17, sec. 15). Removal of body unlawfully from grave is punishable (Gen. Stat., ch. 29, art. 17, sec. 16).

Louisiana.—Coroner shall hold inquest, etc., and bury body when not claimed by friends (Voorh. Rev. L., secs. 653, 660).

Maine.—Coroner to hold inquest, etc. (R. L., ch. 139, sec. 1). To bury the body at State or town expense (R. L., ch. 139, sec. 11). Seizure of body on execution punishable (R. L., ch. 124, sec. 28). Removal, etc., of body unlawfully, or receiving it knowingly, or exposing, etc., body, is punishable (R. L., ch. 124, sec. 27). Body may be buried and the expense recovered from the town (R. L., ch. 24, sec. 34). If any resident request or consent that his body be delivered to a physician or surgeon for dissection, it may be so delivered, unless kindred or family connection objects (R. L., ch. 13, sec. 1). Body of criminal dying in State prison or jail, or who was executed, may be delivered to medical college or physician, etc., for dissection, unless deceased or kindred request to be buried (R. L., ch. 13, sec. 2). Body of person dying in the State, which is not claimed by relatives, notice having been given, shall be delivered to medical college, unless ten voters of the town object to such disposition in writing (Laws, 1893, ch. 254).

Maryland.—Coroner to hold inquest, etc. (Md. Code, art. 22, secs. 3, 4). Shall bury the body when necessary at public expense (Md. Code, art. 22, sec. 7). Removal, etc., from graveyard, etc. (except potter's field), of a body is a misdemeanor (Md. Code, art. 27, secs. 133, 134).

Massachusetts.—Medical examiners shall hold inquest, etc. (Pub. Stat., ch. 26, secs. 10, 11). And shall deliver it to relatives or friends, or if no one claims it, to overseer of poor, etc., for burial (Laws, 1887, ch. 310). Body shall not be buried in city or town, or removed therefrom, without a permit (Laws, 1888, ch. 306). Body of one dying of infectious disease shall not be transported without permit, and only in a sealed case (Laws, 1883, ch. 124, sec. 2). Body shall not be cremated without permit and inquest by medical examiner, or within forty-eight hours after death, unless death was occasioned by contagious disease (Laws, 1885, ch. 265, sec. 4). Overseers of poor, mayor and aldermen of city, or superintendent of State almshouse may deliver body of person required to be buried at public expense to any physician or surgeon or medical college, unless deceased requested to be buried, or relative requests burial or claims it, or deceased was a stranger or traveller (Laws, 1891, ch. 185). Body of criminal executed shall be delivered for dissection to a medical college, if requested ; if not, to friends or relatives, or, if none, to any physician or surgeon (Pub. Stat., ch. 202, sec. 8). Re-

moval of body unlawfully from grave is punishable, or buying, selling, or possessing for such purpose is punishable (Pub. Stat., ch. 207, secs. 47, 48). Concealing of birth of child which, if born alive, would be a bastard is punishable (Pub. Stat., ch. 207, sec. 11). Seizing dead body on execution is punishable (Pub. Stat., ch. 207, sec. 46). Body of a prisoner shall be buried by sheriff at town expense, if not claimed by relatives or friends (Pub. Stat., ch. 220, sec. 31).

Michigan.—Justice of the peace to hold inquest, etc. (How. Am. Stat., vol. ii., sec. 9583 *et seq.*). And shall bury the body at the State or county expense (How. Am. Stat., vol. iii., sec. 9593). Woman concealing death of issue which, if born alive, would be a bastard is punishable (How. Am. Stat., vol. iii., sec. 9284). Board of health, officers, sheriff, etc., of any prison, etc., poor-house, almshouse, having body required to be buried at public expense, shall, if not claimed by relatives or friends, or if it have died of any infectious disease, deliver it to University of Michigan, etc., for dissection, etc. (How. Am. Stat., vol. iii., sec. 2284). Body shall not be shipped out of State nor used in State for any purpose but anatomical study (How. Am. Stat., vol. iii., sec. 2286). Removal of body unlawfully is punishable (How. Am. Stat., vol. ii., sec. 9297).

Minnesota.—Gen. Stat., secs. 6220, 6230, same as N. Y. P. C., secs. 305–315. Concealing birth of child which died before or after birth is a misdemeanor (Gen. Stat., sec. 6210). Coroner to hold inquest, etc. (Gen. Stat., sec. 1011 *et seq.*). And cause body to be buried at expense of county (Gen. Stat., sec. 1021). Section 6216 same as 303, N. Y. P. C. Body must be buried within four days, and if death was from contagious disease, within twenty-four hours, and in a tightly sealed coffin, which must not be reopened (Gen. Stat., sec. 607). Wardens, superintendents of poor, and other persons having control of bodies shall deliver same to medical college committee for dissection, unless claimed by relatives or friends, or relatives or friends do not consent, or one detained as a witness, or on suspicion of having committed a crime, or deceased requested to be buried (Gen. Stat., sec. 678).

Mississippi.—Body of paupers and strangers to be buried (Am. Code, secs. 3145, 3146). Coroner to hold inquest, etc. (Am. Code, sec. 816). Removal of body unlawfully and wantonly for sale, or receiving same, is punishable (Am. Code, secs. 1023, 1024).

Missouri.—Coroner to hold inquest, etc. (R. L., sec. 2438 *et seq.*). And shall bury the body, if not claimed by friends, at public expense (R. L., sec. 2456). And may direct a chemical analysis and microscopical examination of the body (R. L., sec. 2469). Superintendents or wardens of penitentiary, houses of correction, insane asylums, poor-houses, and coroners, sheriff, city and county undertakers, having charge of a body required to be buried at public expense, shall deliver the same to medical college for dissection, unless claimed by friends or relatives, and trafficking in such bodies is a misdemeanor (R. L., sec. 6883 *et seq.*). Concealing birth of child, so

that it may not be known whether it was born alive or dead, is a felony (R. L., sec. 3479). Removal of dead body from grave without authority (except that of criminal executed for crime) for purpose of sale, etc., or receiving such body knowingly, is a felony (R. L., secs. 3842, 3845).

Montana.—Concealing birth of child which, if born alive, would be a bastard is punishable (Crim. Laws, sec. 41). Coroner to hold inquest, etc. (Gen. Laws, secs. 869, 883). And bury body at public expense, if not claimed by relatives, etc. (Gen. Laws, sec. 881). Removal, etc., of body from grave without authority, and for the purpose of sale or dissection, or from wantonness, is a felony (Laws, 1889, p. 114).

Nebraska.—Coroner to hold inquest, etc. (Consol. Stat., sec. 3130 *et seq.*). To bury body, if not claimed by friends (Consol. Stat., sec. 3144). Removal of body from grave without authority for sale, dissection, etc., is punishable (Consol. Stat., sec. 5847). Fœticide is punishable (Consol. Stat., sec. 5582). Bodies of paupers or criminals unclaimed by friends or relatives may be delivered to medical college or physician for dissection, etc., and such body shall not be transported out of State (Consol. Stat., secs. 3299, 3301, 5848).

Nevada.—Justice of peace to hold inquest, etc. (Gen. Stat., sec. 2256 *et seq.*). And cause body to be buried at public expense (Gen. Stat., sec. 2269). Body shall not be buried without certificate of physician or coroner (Gen. Stat., sec. 4872 *et seq.*). Body shall not be transported out of State without a permit (Gen. Stat., secs. 4870, 4871). Concealing birth of child which, if born alive, would be a bastard is punishable (Gen. Stat., sec. 4597). Non-resident *et al.* to be buried at public expense (Gen. Stat., sec. 1986).

New Hampshire.—Coroner to hold inquest, etc. (Pub. Stat., ch. 262, sec. 1 *et seq.*). And bury body, if a stranger, at public expense (Pub. Stat., ch. 262, sec. 16). Concealing birth of child which, if born alive, would be a bastard is punishable (Pub. Stat., ch. 278, sec. 14). Body of person dying in a county, city, or town, or State prison or jail, required to be buried at public expense, shall be delivered to any physician or medical college for dissection, etc., unless deceased requested to be buried, or friends claim it or request burial, or deceased was a stranger or traveller who died suddenly (Pub. Stat., ch. 136). Body not to be buried without a permit, or disinterred (Pub. Stat., ch. 173, sec. 6). Removal of dead body without authority, or concealing it, knowing it to have been so dug up, is punishable (Pub. Stat., ch. 266, sec. 7).

New Jersey.—Coroner to hold inquest, etc. (Rev. Stat., p. 70 *et seq.*). And bury body, if not claimed by friends (Rev. Stat., p. 170, sec. 5). Concealing birth of child which, if born alive, would be a bastard is a misdemeanor (Rev. Stat., p. 241, sec. 83). Body of executed criminal may be delivered to physician, etc., for dissection, unless claimed by relatives (Rev. Stat., p. 239, sec. 69). Removal of a body without authority, for sale, dissection, etc., is a high misdemeanor (Rev. Stat., p. 249, sec. 122). Ex-

posing body of executed murderer is a misdemeanor (Supp. Rev. Stat., p. 194, sec. 19). Body must not be buried without a permit, nor body brought into the State without permit, nor taken out of State without permit (Laws, 1888, ch. 39, secs. 5–8).

New Mexico.—Justice of the peace to hold inquest, etc. (Comp. Laws, sec. 443 *et seq.*). And bury body (Comp. Laws, sec. 447). Body of one dying of a contagious disease shall not be carried in an open coffin, nor be exposed (Laws, 1889, ch. 79, sec. 8). Body shall not be buried within fifty yards of running stream (Laws, 1891, ch. 83).

New York.—Duty of burial, etc. (Penal Code, sec. 305 *et seq.*). Attempt at sexual intercourse with dead body is a crime against nature (Penal Code, sec. 303). Transfer of body of one who died of a contagious or infectious disease shall be in hermetically sealed casket (Laws, 1893, ch. 661, sec. 23). Bodies of those dying in, or in custody of managers, etc., of, any prison, asylum, morgue, hospital, or in possession of undertakers, shall be delivered to medical college of this State, etc., for purpose of medical study, unless claimed by relatives or friends, or friends or relatives do not assent to such disposal, or deceased requested during last illness to be buried (Laws, 1893, ch. 661, sec. 207). In certain cases bodies of convicts, unless claimed, shall be delivered to certain medical colleges (R. S., pt. 4, ch. 3, secs. 132, 133). District attorney may cause body to be exhumed, examined, etc. (Penal Code, sec. 308).

North Carolina.—Coroner to hold inquest, etc. (Code, sec. 657). Concealing birth of a child, by burying dead body, is a misdemeanor. Opening grave without authority for purpose of taking body is a felony (Laws, 1885, ch. 90). Coroner may order a chemical analysis of remains (Laws, 1887, ch. 269). Dead body of convict, unclaimed by friends, shall be delivered to medical college, except such dying of contagious disease (Laws, 1891, ch. 129). Body of one dying of contagious disease must not be transported by common carrier until disinfected, nor shall permit for removal be issued until such disinfection (Laws, 1893, ch. 214, sec. 16).

North Dakota.—Coroner to hold inquest, etc. (Comp. Laws, sec. 664 *et seq.*). And bury the body, if not claimed by friends, etc. (Comp. Laws, sec. 676). Concealing birth of child which, if born alive, would be a bastard, or of child dying within two years after birth, is punishable (Comp. Laws, sec. 6947).

COMP. LAWS.				
Section	6549	same as	305	N. Y. P. C.
"	6550	"	306	"
"	6551	"	307	"
"	6552	"	308 (1–3)	"
"	6553	"	309	"
"	6554	"	310	"
"	6559	"	311	"
"	6660	"	312	"
"	6663	"	314	"

Duty of burial of married woman on husband. If not married woman, on nearest of kin who is an adult or has means sufficient. (Comp. Laws, sec. 6556). Refusal to bury by one on whom duty is imposed by law a misdemeanor (Comp. Laws, sec. 6557). Custody of body pertains to one whose duty it is to bury (Comp. Laws, sec. 6558). When cemetery is by law changed to other place, duty is on relative to move body (Comp. Laws, sec. 6562). Body of executed criminal, and those dying in State penitentiary or county jail under sentence, shall be delivered to medical college or any physician for dissection, unless deceased requested to be buried, or friends ask to have it buried, or deceased was a stranger or traveller (Laws, 1890, ch. 92).

Ohio.—Coroner to hold inquest, etc. (R. L., sec. 1221 *et seq.*). And bury body, etc. (R. L., sec. 1227). Body of pauper or unknown, not an inmate of any penal, charitable, or reformatory institution, and not claimed by relatives or delivered for dissection according to law, shall be buried at public expense (Laws, 1890, p. 283). Corpse shall not be conveyed to or from a city without a permit (R. L., sec. 2119). Bodies of those dying in city hospitals, city or county infirmaries, work-houses, asylums, charitable institutions, penitentiaries, or jails, which are required to be buried at public expense, shall be delivered to medical college or society for study, etc., unless claimed by relative, or deceased was a stranger or traveller (except tramps) (R. L., sec. 3763). Removing body from grave without authority, for dissection, or receiving such body, is punishable (R. L., sec. 7034). Body of executed criminal, if not claimed by relatives or friends, may be delivered for dissection, etc. (R. L., sec. 7343, 1).

Oklahoma.—Coroner to hold inquest, etc. (Stat., sec. 1745 *et seq.*). And bury the body at public expense, if not claimed by relatives (Stat., sec. 1759). Concealing birth of issue which, if born alive, etc., or dying within two years after birth, is punishable (Stat., sec. 2179).

2188–2190 . . .	same as . . .	305–307	N. Y. P. C.	
2191 . . .	" . . .	308	"	(except subd. 4).
2192–2193 . . .	" . . .	309–310	"	
2198 . . .	" . . .	311	"	(except punishment).
2199 . . .	" . . .	312	"	
2202 . . .	" . . .	314	"	

Custody is to him whose duty it is to bury (Stat., secs., 21, 97). Duty of burial of married woman on husband; if not married woman, on nearest of kin who is an adult and has sufficient means (Stat., sec. 2195). Refusal to bury by one on whom duty rests is a misdemeanor (Stat., sec. 2196).

Oregon.—Coroner to hold inquest, etc. (Crim. Code, sec. 453 *et seq.*). And bury body, if not claimed by friends (Crim. Code, sec. 462). Unmarried woman concealing birth of child, so that it may not be known whether it was born alive or not, is punishable (Crim. Code, sec. 649). Bodies of criminals executed, those dying in hospitals, insane asylums, alms-

houses, or penitentiaries, may be delivered to medical college or physician for dissection, etc., unless they shall have been interred, or claimed by relatives, or relatives or friends do not consent, or deceased expressed a wish to be buried; and they shall be used for such purpose only, and in this State (Hill's Am. Laws, sec. 3730 *et seq.*). Removal of body without authority, etc., is punishable (Crim. Code, sec. 656).

Pennsylvania.—Coroner to hold inquest in Philadelphia County only in case of a violent death (Bright's Penn. Dig., 1536, sec. 37). And may in Berks and Lancaster Counties order a post-mortem (Bright's Penn. Dig., 1536, sec. 38). Concealing death of child which, if born alive, would be a bastard is punishable (Bright's Penn. Dig., 431, sec. 158). Removal of body from grave without authority is a misdemeanor (Bright's Penn. Dig., 229, sec. 11). Bodies of those dying in almshouse, hospital, prison, or public institution, or those in morgue, which are required to be buried at public expense, shall be delivered to medical college, physician, etc., to be used for scientific purposes only, unless claimed by relatives, or deceased was a traveller, and trafficking in such bodies is a misdemeanor (Bright's Penn. Dig., 9, sec. 1 *et seq.*).

Rhode Island.—Concealing death of child which, if born alive, would be a bastard, so that it may not be known, etc., is punishable (Pub. Stat., ch. 244, sec. 8). Seizing dead body under execution is punishable (Pub. Stat., ch. 223, sec. 2). Bodies of those dying in jail shall, if not claimed by relatives, be buried at public expense (Pub. Stat., ch. 201, sec. 30). Medical examiner to make autopsy (Pub. Stat., 1884, ch. 420). And bury body of stranger at State expense, if necessary (Pub. Laws, 1884, ch. 420, sec. 24). Coroner to hold inquest if, in opinion of medical examiner, death was caused by act of some one other than deceased (Pub. Laws, 1884, ch. 420, sec. 17).

South Carolina.—Coroner to hold inquest, etc. (R. L., secs. 711, 2664, *et seq.*). And may have body disinterred for inquisition (R. L., sec. 2687).

Tennessee.—Coroner to hold inquest, etc. (Code, sec. 6139 *et seq.*). And may order a chemical analysis of remains, etc. (Code, sec. 6150). Body to be buried, if not claimed by relatives, etc., at public expense, if necessary (Code, sec. 6160). Wilfully or improperly exposing or abandoning a dead body is a misdemeanor (Code, sec. 5658). Removing or purchasing dead bodies without authority is a misdemeanor (Code, secs. 5659, 5660). Body of deceased convict to be buried, unless claimed by friends. (Code, sec. 5402).

Texas.—Justice of the peace to hold inquest, etc. (Code Crim. P., art. 988 *et seq.*). And may disinter the body for such inquisition (Code Crim. P., art. 989). Removal, etc., of dead body from grave without authority is punishable (Code, art. 345). Bodies of convicts to be buried (Rev. C. Stat., art. 3561).

Vermont.—Justice of the peace to hold inquest, etc. (Rev. Laws, sec. 3934 *et seq.*). Removal, etc., of dead body without authority is punishable (Rev. Laws, secs. 4194, 4196). Bodies of those dying in poor-house or other public institution, which are required to be buried at public expense, may be

delivered to any physician for dissection, etc., unless deceased requested to be buried, or friends or relations request burial, or deceased was a stranger or traveller. Such body shall not be removed from State, and shall be used for scientific purposes only (Laws, 1884, ch. 85).

Virginia.—Coroner to hold inquest, etc. (Code, sec. 3938 *et seq.*). And to bury the body at public expense (Code, sec. 3946). Removal, etc., of dead body from grave without authority is punishable (Code, sec. 3794). Bodies of those dying on vessels in State shall be buried by master on shore above high-water-mark (Code, sec. 2002). Bodies of those dying in almshouse, prison, morgue, hospital, jail, or other public institution, which are required to be buried at public expense, and bodies of criminals executed for crime, shall be delivered to medical college, etc., and physician or surgeon for anatomical study, unless (except criminals) relatives or friends claim the body, or deceased was a stranger or traveller, and such bodies shall not be sent out of the State (Code, ch. 80).

Washington.—Coroner to hold inquest, etc. (Hill's Am. Stat., vol. i., sec. 245 *et seq.*) And bury body, if not claimed by friends, at public expense (Hill's Am. Stat., vol. i., sec. 257). Bodies of those dying in poorhouse, public hospital, county jail, State prison, etc., which are required to be buried at public expense, shall be delivered to medical college, physician, surgeon, etc., for study, unless deceased requested to be buried, or it is claimed by relatives or friends, or deceased was a stranger or traveller; and such body shall be used only in the State (Hill's Am. Stat., vol. i., sec. 2428 *et seq.*). Removal, etc., of body from grave without authority is punishable (Penal Code, sec. 208).

West Virginia.—Coroner to hold inquest, etc. (Code, ch. 154). And bury the body at public expense, or, if a stranger, may forward it to its destination and bury it (Code, ch. 154, sec. 8). Removal, etc., of a body from grave is punishable (Code, ch. 149, sec. 13).

Wisconsin.—Justice of the peace or coroner to hold inquest, etc. (S. & B. Am. Stat., ch. 200). And shall cause the body to be buried at public expense (S. & B. Am. Stat., ch. 200, sec. 4877). Dead body of convict shall, if not claimed by relatives or friends, be buried (S. & B. Am. Stat., sec. 4926). Removal, etc., of body from grave without authority is punishable (S. & B. Am. Stat., sec. 4592). Concealing death of child which, if born alive, would be a bastard is punishable (S. & B. Am. Stat., sec. 4585). A public officer having in his charge a body required to be buried at public expense shall deliver same to member of State or county medical society, etc., for anatomical study, unless claimed by relatives, or they consent to such disposal, or deceased requested to be buried, or was a stranger or traveller (S. & B. Am. Stat., sec. 1437).

(From "The Medical Register" of New York, New Jersey, and Connecticut for 1895–96. Published by G. P. Putnam's Sons, New York.)

TABLE SHOWING THE TOTAL NUMBER OF STILL-BIRTHS AND DEATHS (WITH AN ENUMERATION OF SOME OF THE MOST PROMINENT CAUSES) WHICH OCCURRED IN THE CITY OF NEW YORK DURING THE NINETY-ONE YEARS ENDING DECEMBER 31, 1894, AND THE NUMBER OF BIRTHS AND MARRIAGES REPORTED SINCE THE YEAR 1847.

Compiled from the Records of the City Inspector, Metropolitan Board of Health, and Health Department of the City of New York, by JOHN T. NAGLE, M.D., *Registrar of Records.*

Date.—Year ending December 31.	Total Births reported.	Total Marriages reported.	Total Still-Births reported.[1]	Total Deaths.	Number of Deaths from: Small-Pox.	Measles.	Scarlatina.	Diphtheria.	Croup.	Whooping-Cough.	Typhus Fever.	Typhoid Fever.[2]	Cerebro-Spinal Fever.	Fevers not specified.	Cholera.	Yellow Fever.[16]	Diarrhœal Diseases.[3] Under 5 Years.	Diarrhœal Diseases. Total, all Ages.	Relapsing Fever.	Phthisis Pulmonalis.[4]	Pneumonia.	Bronchitis.	Total Deaths of Children under 5 Years of Age.	Population—Estimated or Enumerated.	Death-Rate per 1000 Inhabitants.	Percentage to the Total Mortality: Deaths of Children under 5 Years of Age.	Percentage to the Total Mortality: Deaths of Persons 5 Years of Age and over.
1790	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	[5]33,131	...	...	...
1800	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	[6]60,515	...	...	...
1804	...	...	41	2,084	169	2	14	...	75	19	20	[10]27	...	...	...	...	...	266	...	499	40	...	790	72,557	28.72	37.91	62.09
1805	...	...	47	2,297	62	.	4	...	70	19	78	...	...	...	...	270	...	291	...	462	102	...	823	76,022	30.22	35.83	64.17
1806	...	...	51	2,174	48	..	4	...	100	72	96	...	...	...	...	...	...	228	...	354	127	...	903	79,653	27.29	41.54	58.46
1807	...	...	76	2,236	29	1	2	...	101	35	108	...	...	...	...	...	...	207	...	464	138	...	845	83,456	26.79	37.79	62.21
1808	...	...	64	1,950	62	64	4	...	94	35	65	...	...	...	...	...	...	154	...	429	100	...	756	87,442	22.30	38.77	61.23
1809	...	...	70	2,038	66	2	9	...	102	50	73	...	...	...	...	13	...	186	...	413	106	...	767	91,618	22.24	37.63	62.37
1810	...	...	94	2,073	4	2	1	...	82	44	65	...	...	...	...	...	...	180	...	569	134	...	664	95,993	21.60	32.03	67.97
1811	...	...	93	2,431	117	2	...	...	136	43	156	...	...	...	...	...	...	215	...	595	103	...	853	95,957	25.34	35.09	64.91
1812	...	...	81	2,472	21	9	...	...	111	82	171	...	...	...	...	...	...	150	...	669	225	...	839	95,920	26.10	33.94	66.06
1813	...	...	76	2,207	2	35	1	...	76	89	121	...	...	10	...	...	...	249	...	562	202	...	781	95,884	24.35	35.39	64.61
1814	...	...	93	1,884	2	15	1	...	78	50	142	...	...	19	...	...	...	139	...	572	66	...	606	95,848	19.66	32.17	67.83
1815	...	...	102	2,405	94	18	...	...	83	95	120	...	...	17	...	...	...	154	...	618	202	...	776	99,952	25.12	32.27	67.73
1816	...	...	88	2,651	179	19	...	...	82	44	100	...	...	12	...	...	...	117	...	678	216	...	830	104,232	28.77	31.31	68.69
1817	...	...	118	2,409	14	20	3	...	60	11	163	...	...	12	...	1	...	164	...	574	145	...	831	108,695	22.16	34.50	65.50
1818	...	...	159	3,106	19	18	...	...	74	123	264	...	...	47	...	...	...	319	...	591	178	...	1,150	113,350	27.40	37.03	62.97
1819	...	...	168	3,008	...	10	5	...	68	55	165	...	...	66	...	23	...	444	...	577	141	...	1,173	118,204	26.88	39.00	61.00
1820	...	...	189	3,326	...	74	5	...	97	19	143	...	...	130	...	...	...	491	...	625	155	...	1,293	123,266	20.46	38.88	61.12

1821	. . .	. . .	174	3,368	. . .	109	3	. . .	125	92	128	. .	. .	121	. . .	3	. . .	319	. .	715	157	. . .	1,281	130,040	26.15	38.03	61.97
1822	. . .	. . .	205	3,026	. . .	1	1	. . .	109	34	97	. .	. .	50	. . .	160	. . .	301	. .	624	166	. . .	1,071	138,879	23.12	35.39	64.61
1823	. . .	. . .	223	3,221	18	117	2	. . .	94	31	89	. .	. .	30	. . .	1	. . .	339	. .	683	184	. . .	1,201	147,413	24.09	37.29	62.71
1824	. . .	. . .	250	4,091	394	100	3	. . .	139	116	82	. .	. .	32	. . .	. . .	. . .	299	. .	736	216	. . .	1,608	156,471	27.00	39.31	60.69
1825	. . .	. . .	244	4,774	40	53	10	. . .	132	69	228	. .	. .	120	. . .	. . .	. . .	376	. .	843	328	. . .	1,551	[5]166,086	29.62	32.49	67.51
1826	. . .	. . .	302	4,671	58	31	24	. . .	154	126	137	. .	. .	84	. . .	. . .	. . .	413	. .	820	261	. . .	1,756	172,978	28.68	37.59	62.41
1827	. . .	. . .	291	4,890	149	172	4	. . .	171	61	98	. .	. .	132	. . .	. . .	. . .	555	. .	829	257	. . .	1,980	180,157	28.52	40.49	59.51
1828	. . .	. . .	338	4,843	93	28	11	. . .	155	157	131	. .	. .	91	. . .	. . .	. . .	451	. .	906	231	. . .	1,888	187,634	25.81	38.98	61.02
1829	. . .	. . .	360	4,734	16	91	188	. . .	171	52	57	. .	. .	55	. . .	. . .	. . .	349	. .	880	319	. . .	1,991	195,421	24.22	42.06	57.94
1830	. . .	. . .	339	5,198	176	22	246	. . .	178	97	53	. .	. .	36	. . .	. . .	. . .	389	. .	974	228	. . .	2,300	203,532	27.13	44.25	55.75
1831	. . .	. . .	372	5,991	224	39	258	. . .	203	181	54	. .	. .	69	. . .	. . .	. . .	470	. .	1,033	385	. . .	2,640	215,381	29.47	44.07	55.93
1832	. . .	. . .	384	9,975	89	290	221	. . .	179	63	84	. .	. .	80	3,513	. . .	. . .	4,180	. .	1,415	428	. . .	3,333	227,920	45.00	33.41	66.59
1833	. . .	. . .	392	5,354	25	38	179	. . .	168	105	62	. .	. .	72	. . .	. . .	. . .	281	. .	1,251	406	. . .	2,352	241,188	23.59	43.93	56.07
1834	. . .	. . .	492	8,590	233	212	418	. . .	198	141	106	. .	. .	53	971	. . .	. . .	1,617	. .	1,471	535	. . .	3,872	255,230	34.90	45.08	54.92
1835	. . .	. . .	474	6,608	351	82	174	. . .	173	172	46	. .	. .	47	. . .	. . .	. . .	401	. .	1,437	472	. . .	3,140	[5]270,098	26.27	47.52	52.48
1836	. . .	. . .	506	7,503	173	443	202	. . .	177	152	117	. .	. .	90	. . .	. . .	. . .	499	. .	1,514	551	. . .	3,681	278,275	28.99	49.06	50.94
1837	. . .	. . .	550	8,182	170	238	579	. . .	151	63	338	. .	. .	130	. . .	. . .	. . .	548	. .	1,458	635	. . .	3,908	286,719	30.08	47.76	52.24
1838	. . .	. . .	520	7,533	91	79	257	. . .	182	219	104	. .	[6]2	56	. . .	. . .	. . .	733	. .	1,225	599	. . .	3,806	295,400	26.78	50.52	49.48
1839	. . .	. . .	592	7,361	69	133	158	. . .	141	113	97	[8]16	. .	55	2	2	. . .	752	. .	1,318	496	[7]72	3,651	304,353	25.99	49.60	50.40
1840	. . .	. . .	606	7,868	234	185	391	. . .	146	73	95	26	. .	73	1	. . .	. . .	683	. .	1,296	557	59	3,926	313,578	27.01	49.90	50.10
1841	. . .	. . .	584	8,531	220	113	366	. . .	120	67	144	38	. .	76	. . .	. . .	. . .	808	. .	1,470	669	78	4,111	324,342	28.04	48.19	51.81
1842	. . .	. . .	701	8,475	181	60	416	. . .	120	191	214	[10]12	. .	. . .	. . .	. . .	. . .	796	. .	1,339	581	84	4,123	335,475	27.29	48.65	51.35
1843	. . .	. . .	687	8,006	119	118	223	. . .	162	63	68	33	. .	57	. . .	. . .	. . .	648	. .	1,503	597	79	3,828	346,991	24.96	47.81	52.10
1844	. . .	. . .	767	8,188	20	51	224	. . .	276	163	131	. . .	. .	113	30	. .	484	615	. .	1,438	598	89	3,847	358,902	24.77	16.98	53.02
1845	. . .	. . .	862	10,122	425	136	63	. . .	222	89	175	[10]21	. .	39	6	. . .	. . .	908	. .	1,659	753	90	4,911	[6]371,223	27.27	48.52	51.48
1846	. . .	. . .	883	10,435	141	17	114	. . .	190	214	[9]262	2 [10]15	. .	53	. . .	. . .	. . .	1,047	. .	1,698	573	108	4,982	396,686	28.77	47.74	52.26
1847	[12]317	[12]185	944	14,844	53	275	142	. . .	271	86	948	[10]473	. .	252	. . .	. . .	. . .	1,981	. .	1,926	750	139	6,315	423,896	35.02	42.54	57.46
1848	170	199	1,027	14,892	585	77	93	. . .	319	213	720	[10]249	. .	143	2	. .	1,044	1,721	. .	1,869	738	170	6,717	452,972	32.88	45.10	54.90
1849	. . .	. . .	1,168	22,605	372	125	266	. . .	292	112	415	[10]221	.	153	5,071	. .	2,420	8,277	. .	2,086	955	161	8,905	484,043	46.70	39.39	60.61
1850	. . .	. . .	1,152	15,826	241	324	311	. . .	356	180	396	[10]112	[6]1	96	57	. .	1,413	2,079	. .	1,928	966	132	7,873	517,246	30.60	49.75	50.25
1851	. . .	. . .	1,286	20,738	586	320	627	. . .	462	114	977	[10]156	. .	147	. . .	. .	1,718	2,759	. .	2,374	1,315	254	10,505	538,490	38.51	50.66	49.34
1852	. . .	. . .	1,405	20,196	516	246	613	. . .	595	187	662	[10]147	. .	172	374	1	. . .	2,868	. .	2,487	1,084	230	10,427	560,607	36.02	51.63	48.37
1853	[13]10,157	[13]3,203	1,575	21,127	681	134	454	. . .	673	158	399	[10]171	. .	97	33	5	1,842	2,479	. .	2,739	1,071	283	11,033	583,632	37.65	52.22	47.78
1854	17,979	5,595	1,615	26,953	624	362	517	. . .	637	340	390	[10]189	. .	50	2,509	6	2,986	6,302	. .	3,032	1,297	290	13,623	607,603	46.86	50.54	49.46
1855	14,145	4,199	1,564	21,478	107	383	1,052	. . .	538	377	439	172	. .	55	19	2	2,122	2,542	. .	2,635	1,242	368	12,125	632,559	38.65	56.45	43.55

[1] Premature births are included in this column from 1804 to 1837 inclusive, and also in the year 1842. From 1861 to 1865 there are no statistics of still-births.

[2] See typhus fever.

[3] Include cholera, cholera infantum, cholera morbus, diarrhœa, dysentery, entero-colitis, and diarrhœal enteritis and gastro-enteritis.

[4] Includes diseases of the lungs.

[5] The United States or State Census of the population, which is taken every ten years; the population for the balance of the years is estimated.

[6] Spotted fever.

[7] The first year that deaths were tabulated from bronchitis.

[8] The first year that deaths were tabulated from typhoid fever.

[9] Including typhoid, see typhus.

[10] Including the following number of deaths certified as nervous fever: 1804, 27 deaths; 1842, 12; 1845, 21; 1846, 15; 1847, 25; 1848, 26; 1849, 34; 1850, 36; 1851, 31; 1852, 51; 1853, 34; 1854, 33; 1855, 33.

[11] Including nervous fever.

[12] First year of registration.

[13] From July 1 to December 31.

[14] In the year 1795, 714 deaths were reported to have occurred from yellow fever.

In 1838, 30 premature births; in 1839, 45; 1840, 50; 1841, 38; 1843, 73; 1844, 141; 1845, 103; 1846, 116; 1847, 114; 1848, 134; 1849, 152; 1850, 183; 1851, 220; 1852, 225; 1853, 355; 1854, 435; 1855, 374. Were not added to the deaths or still-births.

TABLE SHOWING THE TOTAL NUMBER OF STILL-BIRTHS AND DEATHS—*Continued.*

Date.—Year ending December 31.	Total Births reported.	Total Marriages reported.	Total Still-Births reported.[1] [11]	Total Deaths.	Number of Deaths from																			Total Deaths of Children under 5 Years of Age.	Population—Estimated or Enumerated.	Death-Rate per 1000 Inhabitants.	Percentage to the Total Mortality.	
					Small-Pox.	Measles.	Scarlatina.	Diphtheria.	Croup.	Whooping-Cough.	Typhus Fever.	Typhoid Fever.[2]	Cerebro-Spinal Fever.	Fevers not specified.	Cholera.	Yellow Fever.	Diarrhœal Diseases.[3] Under 5 Years.	Diarrhœal Diseases.[3] Total, all Ages.	Relapsing Fever.	Phthisis Pulmonalis.[4]	Pneumonia.	Bronchitis.				Deaths of Children under 5 Years of Age.	Deaths of Persons 5 Years of Age and over.
1856	16,199	3,633	1,556	20,102	396	330	1,283	. . .	550	248	231	158	. .	56	8	13	2,031	2,360	. .	2,478	866	293	11,817	664,980	32.70	58.78	41.22
1857	18,427	3,710	1,558	21,775	434	322	1,325	[6]2	560	270	171	155	. .	37	11	. .	1,880	2,232	. .	2,814	1,109	360	12,681	699,062	32.63	58.24	41.76
1858	13,340	3,942	1,498	22,196	511	392	668	[6]3	478	347	126	211	. .	18	5	5	2,223	2,577	. .	3,046	1,243	343	12,714	734,892	31.66	57.28	42.72
1859	9,035	3,100	1,331	21,645	62	261	840	[7]53	622	353	174	218	. .	38	9	4	1,807	2,195	. .	3,239	1,193	310	11,932	772,558	30.95	55.13	44.87
1860	12,454	4,241	1,638	22,710	289	197	1,927	422	599	217	198	232	. .	. .	18	2	. . .	1,885	. .	3,186	1,326	336	12,133	812,154	30.49	53.43	46.57
1861	10,004	2,993	[10]379	22,117	616	376	1,278	453	460	160	190	245	[8]1	6	12	. .	1,634	1,981	. .	3,025	1,257	424	11,952	794,905	30.85	54.04	45.96
1862	7,612	2,896	. . .	21,244	269	128	928	594	685	255	136	417	. .	24	9	. .	1,686	2,028	. .	3,170	1,103	320	11,094	778,023	29.75	52.22	47.78
1863	6,426	3,272	. . .	25,196	78	215	903	980	908	127	420	531	. .	. .	9	.	2,367	2,671	. .	3,485	1,713	400	12,727	761,500	34.95	50.51	49.49
1864	5,877	2,675	. . .	25,645	394	263	899	781	754	143	764	661	. .	. .	12	2	1,977	2,573	. .	3,615	1,831	441	13,427	745,327	34.60	52.36	47.64
1865	5,332	2,733	. . .	24,843	674	146	571	534	449	268	501	573	. .	. .	10	. .	2,144	2,836	. .	3,394	1,706	520	12,802	729,498	35.32	51.53	48.47
1866	10,006	5,792	[8]953	26,815	44	153	806	435	368	114	433	514	[9]18	. .	1,137	. .	2,856	4,880	. .	3,481	1,388	557	12,671	767,979	34.92	47.25	52.75
1867	12,535	7,144	2,279	23,103	19	499	655	248	333	155	180	347	32	. .	27	3	2,581	3,076	. .	3,256	1,434	695	12,240	808,489	28.64	52.98	47.02
1868	12,590	6,926	2,195	24,889	26	200	861	277	342	217	137	329	34	. .	9	1	3,322	3,837	. .	3,414	1,668	803	13,067	851,137	29.25	52.50	47.50
1869	13,947	8,695	2,215	25,167	203	526	966	328	483	358	125	378	42	. .	6	1	2,676	3,134	. .	3,364	2,100	877	12,859	896,034	28.09	91.09	48.91
1870	14,524	7,985	2,254	27,175	293	298	975	308	421	201	96	422	32	. .	1	3	3,511	3,956	184	4,030	1,836	855	13,333	943,300	28.81	49.06	50.94
1871	20,821	8,646	2,276	26,976	805	409	791	238	466	465	65	239	48	. .	6	2	3,250	3,653	6	4,186	1,834	964	12,971	955,921	28.22	48.08	51.92
1872	22,068	9,008	2,322	32,647	929	463	990	446	675	565	86	364	782	. .	4	. .	4,680	5,197	3	4,274	2,150	1,040	16,188	968,710	33.70	49.58	50.42
1873	22,683	8,871	2,312	29,084	117	306	1,045	1,151	732	268	39	294	290	. .	1	3	3,634	4,097	2	4,134	2,328	1,068	14,182	981,671	29.63	48.76	51.24
1874	25,747	8,397	2,261	28,727	484	319	879	1,665	594	489	14	275	158	. .	2	. .	3,227	3,569	1	4,034	2,398	1,065	13,956	1,030,607	27.87	48.58	51.42
1875	23,813	7,565	2,274	30,709	1,280	167	514	2,329	758	407	28	347	146	. .	. . .	. .	3,352	3,738	. .	4,172	2,802	1,111	14,848	1,044,396	29.39	48.35	51.65
1876	23,744	7,099	2,290	29,152	315	362	891	1,750	527	406	20	283	127	. .	. . .	1	3,413	3,782	. .	4,194	2,542	1,214	14,210	1,075,532	27.11	48.74	51.26
1877	25,569	7,129	2,164	26,203	14	155	983	951	472	440	17	275	116	. .	2	1	3,187	3,557	1	4,044	2,148	1,033	12,307	1,107,597	23.65	46.97	53.03
1878	25,729	7,629	2,192	27,008	2	272	1,099	1,007	499	382	4	245	97	. .	. . .	. .	2,598	2,945	. .	4,466	2,288	1,184	12,410	1,140,617	23.68	45.95	54.05
1879	25,573	8,446	2,191	28,342	25	244	1,477	671	522	537	4	178	108	. .	. . .	2	2,592	2,965	. .	4,343	2,554	1,263	12,777	1,174,621	24.13	45.08	54.92
1880	27,536	9,002	2,362	31,937	31	479	618	1,390	910	277	3	241	170	. .	. . .	1	3,469	3,947	. .	4,706	2,822	1,375	14,650	1,209,191	26.41	45.87	54.13
1881	26,130	10,077	2,462	38,624	451	429	1,964	2,249	1,038	286	160	446	461	. .	. . .	. .	3,710	4,270	. .	5,312	3,261	1,511	17,737	1,244,451	31.04	45.92	54.08
1882	27,321	11,085	2,658	37,924	259	913	2,066	1,525	729	658	65	362	238	. .	. . .	. .	3,479	4,050	. .	5,247	3,472	1,583	17,520	1,280,740	29.61	46.20	53.80
1883	28,972	11,556	2,697	34,011	12	716	744	1,009	644	327	15	471	223	. .	. . .	. .	2,897	3,398	. .	5,290	3,409	1,435	13,856	1,318,086	25.80	40.74	59.26
1884	30,527	11,805	2,908	35,034	. . .	762	608	1,090	748	490	27	389	210	. .	. . .	3	3,160	3,679	. .	5,235	3,159	1,485	15,292	1,356,522	25.83	43.59	56.41
1885	30,030	11,716	2,968	35,682	26	736	559	1,325	855	495	15	294	202	. .	. . .	1	2,892	3,426	. .	5,196	3,649	1,605	15,267	1,396,079	25.56	42.79	57.21
1886	31,319	12,216	3,050	37,351	31	668	371	1,727	968	575	14	325	223	. .	. . .	1	2,990	3,494	. .	5,477	3,657	1,701	16,121	1,436,789	26.00	43.16	56.84
1887	34,023	13,740	3,100	38,933	99	767	589	2,167	889	188	. .	323	203	. .	. . .	. .	3,252	3,762	. .	5,260	3,707	1,838	16,766	1,478,686	26.33	43.06	56.94

1888	36,136	14,533	3,239	40,175	81	591	1,361	1,914	639	573	4	364	173	. .	. . .	3	3,051	3,489	. .	5,260	4,288	1,892	17,360	1,521,805	26.40	43.21	56.79
1889	37,525	14,400	3,349	39,679	1	470	1,242	1,686	605	647	. .	397	145	. .	. . .	. .	3,135	3,648	. .	5,179	4,075	1,314	17,152	1,566,181	25.33	43.23	56.77
1890	39,250	14,992	3,315	40,103	2	730	408	1,262	521	487	. .	352	136	. .	. . .	. .	2,997	3,346	. .	5,492	4,989	1,987	16,305	1,611,851	24.88	40.66	59.34
1891	46,904	15,764	3,414	43,659	2	663	1,220	1,361	609	352	1	384	189	. .	. . .	. .	3,191	3,587	. .	5,160	5,818	1,836	18,224	1,658,853	26.32	41.74	58.26
1892	49,447	16,001	3,573	44,329	81	864	977	1,436	670	371	45	400	230	. .	9	1	3,162	3,499	. .	5,033	5,841	1,754	18,684	1,707,226	25.97	42.15	57.85
1893	51,529	16,144	3,645	44,486	102	393	551	1,970	538	542	200	381	469	. .	. . .	. .	2,898	3,310	. .	5,124	6,487	1,577	17,865	1,757,009	25.32	40.16	59.84
1894	55,636	17,388	3,575	41,175	154	584	541	2,359	511	272	. .	326	213	1	. . .	. .	2,708	3,040	. .	4,658	4,725	1,329	17,558	1,808,244	22.77	42.64	57.36

1 Premature births are included in this column from 1804 to 1837 inclusive, and also in the year 1842. From 1861 to 1865 there are no statistics of still-births.

2 See typhus fever.

3 Include cholera, cholera infantum, cholera morbus, diarrhœa, dysentery, entero-colitis, and diarrhœal enteritis and gastro-enteritis.

4 Includes diseases of the lungs.

5 Spotted fever.

6 Malignant sore throat.

7 First year that diphtheria was tabulated.

8 For the nine months ending December 31, 1866.

9 First year that cerebro-spinal fever was tabulated.

10 First four months of the year.

11 Still-births from 1862 to 1865 cannot be ascertained.

Influenza caused 7 deaths in 1889, 314 in 1890, 854 in 1891, 495 in 1892, 227 in 1893, 188 in 1894. Deaths from typho-malarial fever ought to be included with typhoid fever, and the following deaths from the former ought to be added to the latter,—viz., 1871, 22; 1872, 22; 1873, 29.

NOTE.—There was no law previous to 1851 that required the registration of deaths of persons buried within the city limits. The figures given for these years are in excess of the registered number of deaths, and indicate that a large number of such deaths were either voluntarily reported or that the Registrar received returns of interments from cemeteries located in the city. It will therefore be seen that the death-rates given for the years previous to 1851 are below the actual rate.

DIFFERENTIAL DIAGNOSIS

By MR. GEO. A. HUNTLEY,

	URÆMIC COMA.	DIABETIC COMA.	APOPLECTIC COMA.	ALCOHOLIC COMA.	OPIUM COMA.	BELLADONNA COMA.
1. History	Bright's disease.	Diabetes.	Apoplexy (usually left side).	Alcoholism (usually males).	. . . .	. . . .
2. Onset	Delirium or convulsions.	Slow, with somnolency and great oppression.	Sudden.	Delirium.	Gradual.	Dryness of mouth and throat.
3. Inspection, etc.						
(*a*) Face	Waxy.	Pale.	Pale.	Flushed and swollen; conjunctiva congested; tongue negative.	Pale.	Flushed.
(*b*) Body	General œdema.	. . . .	Emaciation.	Surface of body hot; no loss of semen.	Cold sweat.	Skin hot and dry.
(*c*) Trauma . .	. . . .	. . . .	No signs of injury.	. . . .	. . . .	. . . .
(*d*) Hemorrhage	. . . .	. . . .	No oozing from nose or ears.	. . . .	. . . .	. . . .
(*e*) Paralysis . .	. . . .	No true paralysis.	Hemiplegia.	No paralysis.	No paralysis.	. . . .
(*f*) Pupils . . .	. . . .	Regular.	Irregular.	Dilated.	Contracted; insensible to light.	Dilated.
(*g*) Respiration .	Stertorous.	Rapid, shallow.	Slow and stertorous.	"Steamboat."	Very slow and irregular.	Slow and deep.
4. Temperature . .	Usually high.	Normal.	Elevated, specially on paralyzed side.	Low.	. . . .	Often raised.
5. Pulse	Full and strong; not rapid.	Rapid and weak.	Weak, small, slow.	Full and strong.	Slow.	Greatly increased.
6. Odor	Uriniferous about patient.	Breath smells sweet.	Breath and urine smell sweet.	Breath of alcohol.	Opium in breath.	. . . .
7. Urine.						
(*a*) Chemical . .	Albumen and casts.	Sugar.	. . . .	Alcohol.	Opium.	. . . .
(*b*) Quantity . .	Scanty and retained.	Large quantities passed involuntarily.	Abundant, passed involuntarily.	Retained.	. . . .	Retained.
8. Enteric and Gastric . . .	No diarrhœa.	. . . .	Retention of fæces.	Vomiting common.	. . . .	. . . .
9. Convulsions . .	Repeated convulsions.	None.	. . . .	None.	. . . .	. . . .
10. Condition . . .	Coma complete.	Cannot be aroused; gradually deepens.	Stupor intense from first. .	Aroused with ammonia or shaking, lasts for hours, gradually lessens.	Coma deepens gradually, noise may rouse, shaking will not.	Coma preceded by delirium.
11. Treatment . . .	Pilocarp. hypodermic; croton oil, ♏i; venesection if plethoric; chloroform inhalation; sustain heart.	Inhalation of O; intravenous injection of saline solution; if convulsions, opium.	Head high; reduce arterial pressure; venesection; ice-bag to head; heat to extremities; purge followed by alteratives.	Hypo. of apomorphine; empty stomach; cold to head; heat to extremities; sustain heart with strychnine.	Wash stomach; strong coffee, Oi, injected in rectum; atropinæ sulph. subcutaneously; artificial respiration.	Emetics or wash out stomach; inject pilocarpine and stimulants subcutaneously.

N.B.—Remember that feigned Coma

AND TREATMENT OF COMA.

UNIVERSITY OF VERMONT.

ASPHYXIA.	CONGESTIVE COMA (Insolation).	EPILEPTIC COMA.	HYSTERICAL COMA.	SYNCOPE (Cerebral Anæmia).	COMA RESULT OF INJURY (Meningeal Hem.).	CATALEPSY.
Exposure to gas or foul air.	Exposure to heat.	Epilepsy.	Hysteria (usually females).	. . . .	Injury; may recover and relapse.	Hysteria.
. . . .	Gradual.	. . . .	Sudden.	Sudden.	. . . .	Consciousness suddenly lost.
Tongue and lips livid and blue.	Flushed.	Pale or cyanotic; froth about mouth; tongue bitten.	. . . .	Pale.	. . . .	Expressionless; deathlike.
Surface dry and hot.	No œdema.	Frequent loss of semen.	Flushed and hot.	Surface cold and perspiring.	. . . .	Skin cold, limbs plastic, remain in any position in which placed.
. . . .	. . . .	. . . .	. . . .	. . . .	Signs of head injury.	. . . .
. . . .	. . . .	. . . .	. . . .	. . . .	Blood or serous discharge common.	. . . .
. . . .	No true paralysis.	. . . .	. . . .	. . . .	Both sides may be affected.	. . . .
Contracted (?).	Contracted.	. . . .	Normal; sensitive to light.	. . . .	. . . .	. . . .
Embarrassed (œdema of the lungs).	Usually quiet.	Normal.	No stertor.	Weak, but not restricted.	Slow and stertorous.	Weak.
Low.	High.	High.	. . . .	. . . .	Probably high.	2° or 3° below normal.
Weak, small, rapid.	Rapid.	Not much affected.	. . . .	Not felt at wrist (heart principally affected).	Frequent.	Weak.
Breath contains large amount of CO_2.	. . . .	No odor to breath.	No odor to breath.	. . . .	. . . .	. . . .
. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .
. . . .	Passed involuntarily.	. . . .	Incontinence.	. . . .	. . . .	. . . .
. . . .	Involuntary diarrhœal discharges.	. . . .	No diarrhœa; no vomiting.	. . . .	. . . .	. . . .
May end in convulsions.	With or without slight convulsions.	Follows convulsions.	. . . .	. . . .	. . . .	. . . .
Cannot be aroused.	Coma yields readily to treatment.	Cannot be aroused; short duration.	Coma alternates with hysterical delirium.	Coma short duration.	Gradually increasing stupor.	Attack may be repeated without intermediate symptoms.
Fresh air; inhalation of O; artificial respiration; if by CO transfusion of blood is indicated.	Application of cold to entire body; cold enemata; stimulants.	Attention to protection of body from cold or heat; wait for consciousness.	Little need be done; application of cold; Sp. ammoniæ arom.	Lower head; stimulants; smelling salts; cold water to face; autotransfusion.	Operate early; remove blood-clot and ligate artery if necessary.	Arouse with ammonia; emetics often cut short an attack; between attacks tonics and valerian.

often misleads the most practical expert.

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Etc., etc.

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